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GEOLOGY, ENERGY AND MINERAL RESOURCES ASSESSMENT OF THE HOT SPRINGS AREA, ARIZONA

BY

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Table 4: Geological environments of the Hot Springs area and associated potential mineral deposit types.

GEOLOGY, ENERGY AND MINERAL RESOURCES ASSESSMENT IN THE HOT SPRINGS AREA, ARIZONA

by

Antoni Wodzicki, Jan Krason, and Susan K. Cruver

SUMMARY

The Hot Springs "Geological Energy and Mineral (GEM) Resources Area (GRA) lies within Yavapai and Maricopa Counties, central Arizona, and contains the South Bradshaws East (020-084A) and South Canyon (020-119) Wilderness Study Areas (WSAs). The GRA is largely within the Mountain Region, which lies between the Colorado Plateau to the northeast and the Desert Section of the Basin and Range Province to the southwest.

The oldest rocks within the GRA consist of the Yavapai Series which are 1.82-1.775 b.y. old and consist of some 40,000 feet of mafic to felsic submarine volcanics and clastic sediments. This greenstone belt has been folded, metamorphosed and intruded by granites 1.76-1.63 b.y.B.P. There is no record of sedimentary deposition or igneous activity in this area until the Laramide orogeny at which time small granodionite plutons were intruded into the Precambrian schist and granite. During the mid-Tertiary 40-20 m.y.B.P., a thick sequence of fluvial lacustrine and calc-alkaline volcanic rocks were deposited in the Phoenix basin which extends into the southern part of the GRA. During the Late Tertiary (20-9 m.y.B.P.) basalt flows were erupted, and to the south of the GRA basin and range faulting became important. During the last 9 m.y. volcanism and tectonism subsided and the dominant geologic processes have been erosion and deposition of alluvium.

Geological environments potentially favorable for the occurrence of mineral and/or energy resources in the GRA include Precambrian felsic metavolcanics, Precambrian granite contacts, Laramide plutons, mid-Tertiary plutons and volcanics, mid-Tertiary basin-fill sediments, alluvium and active geothermal systems. The felsic volcanics within the Yavapai Series are locally associated with copper, zinc, gold and silver-bearing massive sulfide deposits and eleven such occurrences are known within the GRA. Minor tungsten-bearing veins may be associated with Precambrian granite contacts, and four such occurrences are present in the GRA. At least 17 Au, Ag, and base metal occurrences are associated with small Laramide plutons. They occur mainly as veins along shears but at least one occurrence is a breccia pipe. All are found in the northern part of the GRA, close to the intersection of ENE and NW trends, along which porphyry copper deposits are found elsewhere in Arizona. At least 33 Au, Ag and base metal occurrences are associated with the mid-Tertiary rhyolite porphyry and granite intrusive into Precambrian rocks and Tertiary volcanics. They occur mainly as veins along shears but one contains minerals disseminated in rhyolite porphyry. Four minor uranium occurrences are present in carbonate beds within mid-Tertiary valley-fill

sediments which contain suitable source rocks, aquifers and possibly buried reductants. Four placer occurrences are present within recent alluvium in the Agua Fria drainage system. One well and three hot springs to the north of the South Canyon WSA discharge waters at 44°-55°C. The South Bradshaws East WSA is underlain by Precambrian quartz monzonite. It is classified as having low favorability for metallic minerals because no occurrences are known in the WSA, but elsewhere in the GRA, in similar geologic environments, small deposits are associated with Precambrian granite contacts, Laramide intrusives and mid-Tertiary intrusives.

The South Canyon WSA is underlain by Precambrian schist and mid-Tertiary volcanics and intrusives. A small gold-bearing vein with minor production occurs in volcanics in the central part of the WSA and this area is classified as moderately favorable for metallic minerals. In the west-central part of the WSA extensive Ag, Au and Cu mineralization is associated with hydrothermally altered quartz monzonite and this area is classified as highly favorable for metallic deposits. Other parts of the WSA have low favorability for metallic minerals, uranium, non-metallic minerals and geothermal potential.

Important recommendations for further work in the WSAs include:

1. Field checking for presence of extensive hydrothermal alteration and widespread mineralization.
2. Radiometric dating to determine whether alteration was Precambrian, Laramide or mid-Tertiary.

INTRODUCTION

Purpose and Methodology

The need for "Geological, Energy and Minerals (GEM) Resources Assessment" of "Wilderness Study Areas" (WSA) has been recognized for some time by the Bureau of Land Management (BLM). The assessment is now being performed by various contractors for the BLM.

Wilderness Study Areas, widely scattered within the Sonoran Desert and Mexican Highlands and grouped into Region 5 by the BLM, are being studied and assessed by Geoexplorers International. The present report pertains to two WSAs in southwestern Arizona which have been grouped together into the Hot Springs Geological Energy and Minerals Resources Area (GRA).

The purpose of the present study is to assess the potential for locateable, leasable and saleable resources within the GRA, and specifically within each of the WSAs. This assessment has been carried out through literature study of the geology, structure and economic geology of the GRA, and a consideration of the regional paleogeographic, plate tectonic and metallogenic setting of the GRA within the southern Cordillera. Thus, the assessment is not only based on data from the GRA itself, but also on metallogenic concepts within the regional paleogeographic and plate tectonic framework.

Location and Access

The Hot Springs GRA is located in Yavapai and Maricopa Counties, central Arizona. It lies within the Phoenix Resource Area of the BLM-administered Phoenix District. It occupies the southeastern corner of the Prescott

1:250,000 quadrangle and the northeastern corner of the Phoenix 1:250,000 quadrangle, approximately between latitudes 34° 20′ N and 33° 50′ N and longitudes 112° 00′ W and 112° 30′ W. The two WSAs within the Hot Springs GRA are described in Table 1.

TABLE 1. Wilderness Study Areas in the Hot Springs GRA

WSA No.	WSA Name	Acres	km^2
020-084A	South Bradshaws East	640	2.59
020-119	South Canyon or Hells Canyon	9379	37.95
	Total	10019	40.54

Important access into the GRA is provided by Arizona Highway 17 which runs north-south through the eastern side of the area. Elsewhere access is by light duty and unimproved roads. No major towns like within the GRA, but Prescott lies 12 miles north, and Phoenix some 20 miles south of the GRA.

PHYSIOGRAPHY

The GRA lies within the Basin and Range Province of Fenneman (1931). The southern part lies in the Desert Region, whereas the rest is within the Mountain Region of the Basin and Range (Wilson, 1962; see fig. 1).

The Mountain Region part of the GRA is divided into the western and eastern parts by the Agua Fria River Valley which runs north-south through the east-central part of the GRA. The western two-thirds of this Region is mountainous terrain of the Bradshaw and Hieroglyphic Mountains, the former rising to 7000 feet. The topography is steep and the relief is up to 5000 feet. To the east of the Agua Fria River lies a basalt-capped plateau at an elevation of 3500 feet, and the New River Mountains which rise to 5000 feet have a relief of about 2000 feet.

The Desert Region of the GRA slopes gently southward toward the Phoenix basin.

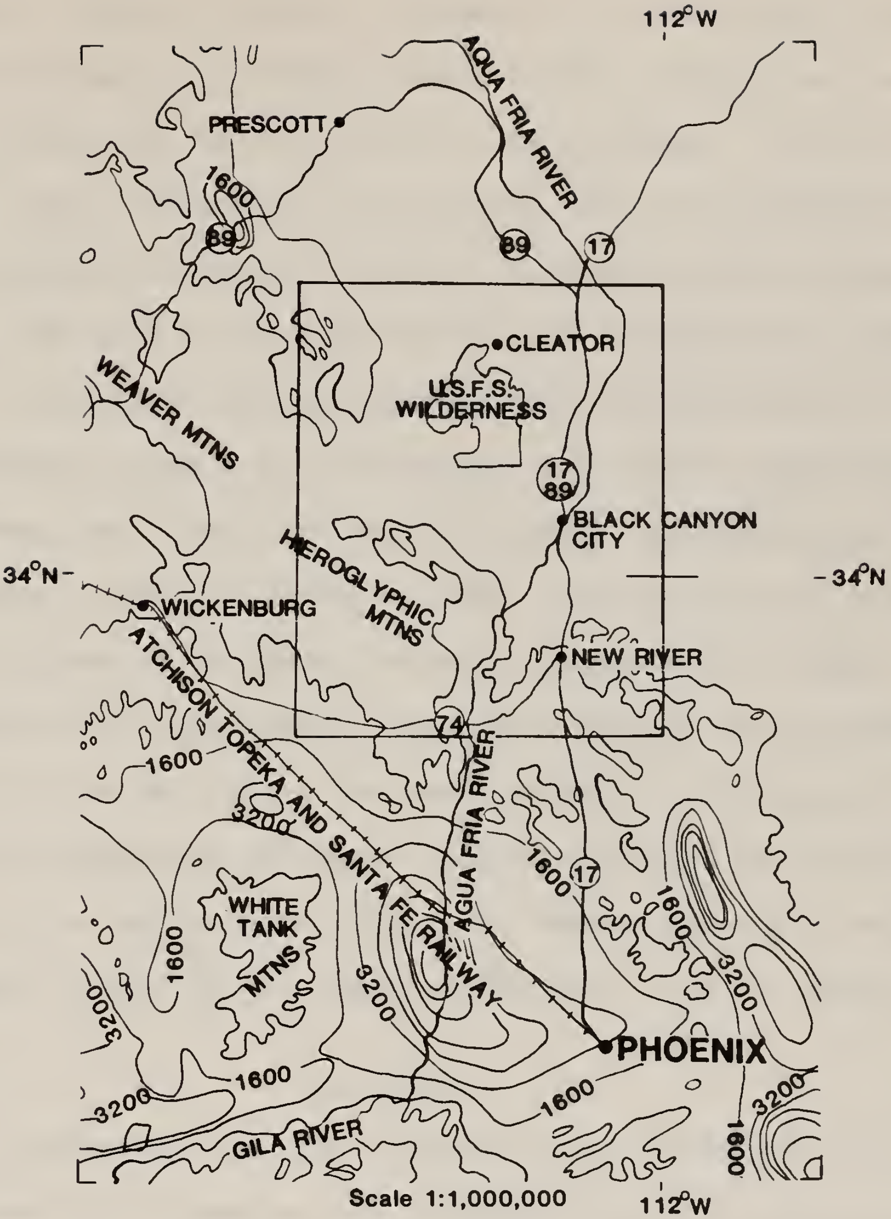


Figure 1. LOCATION OF THE HOT SPRINGS GRA. Surface physiography and depth to basement contours (1600 feet interval), after Oppenheimer and Sumner (1981).

GEOLOGY

The Mountain Region of central Arizona is an area where the geology is transitional between the Colorado Plateau to the northeast and the Desert section of the Basin and Range Province to the southwest. In the Colorado Plateau area, little deformation has occurred since the Precambrian, and Paleozoic and Mesozoic sedimentary rocks are typically little deformed. To the southwest, the area has been affected by a mid-Mesozoic orogeny and magmatic arc; a Laramide orogeny magmatic arc and metallogenic event; a mid-Tertiary orogeny, magmatic arc, metamorphic core complex emplacement and a metallogenic event; and a Basin and Range disturbance accompanied by basaltic and locally bimodal volcanism (Reynolds, 1980). The structure in this southwestern part of Arizona is in general extremely complex (Davis, 1981).

The lithology and stratigraphy, structural geology and tectonics, and geologic history of the Hot Springs GRA are described in this section in order to facilitate the assessment of mineral potential within the GRA, and specifically within the two enclosed WSAs. The regional geologic setting and detailed geology of the GRA are shown in Figures 2 and 3, respectively.

Rock Units

In the Hot Springs GRA rock units present include metamorphic and igneous rocks, Cretaceous (?) intermediate and felsic volcanic rocks and intrusives, and Late-Tertiary valley-fill sediments and basaltic volcanics.

Older Precambrian Rocks

Older Precambrian rocks in Arizona crop out extensively along the northwest-trending Mountain Region which encompasses the GRA. They have been divided into three distinct northeast-trending belts (see fig. 2A; Titley, 1982), which according to Anderson (1976) accreted onto the North American

Figure 2: Paleotectonic and paleogeographic maps of Arizona showing location of the Hot Springs GRA.

A. Location of Precambrian terrains and the Holbrook, Bright Angle-Mesa Butte and Colorado lineaments, after Warner (1978) and Titley (1982).

B. Location of mid-Mesozoic magmatic arc, the Mojave-Sonora megashear and mid- to late Mesozoic red beds, after Dickinson (1981). The red beds postdate the magmatic arc and probably extend farther to the southwest than shown.

C. Location and age trends of major porphyry copper deposits. Note that these are aligned parallel to northwest-trending Paleozoic-Mesozoic discontinuities (Lowell, 1974; numbers 1-6 correspond to discontinuities named in Heidrick and Titley, 1982), along northwest-trending Laramide magmatic arcs (v pattern), and along northeasterly Precambrian trends (Heidrick and Titley, 1982). Curved black lines show location of arc at different times, as given.

D. Location of Precambrian alkali and alkali-calcic intrusions and mid-Tertiary metamorphic core complexes, mid-Tertiary alkali-calcic volcanics and sedimentary domains (Scarborough and Wilt, 1979).

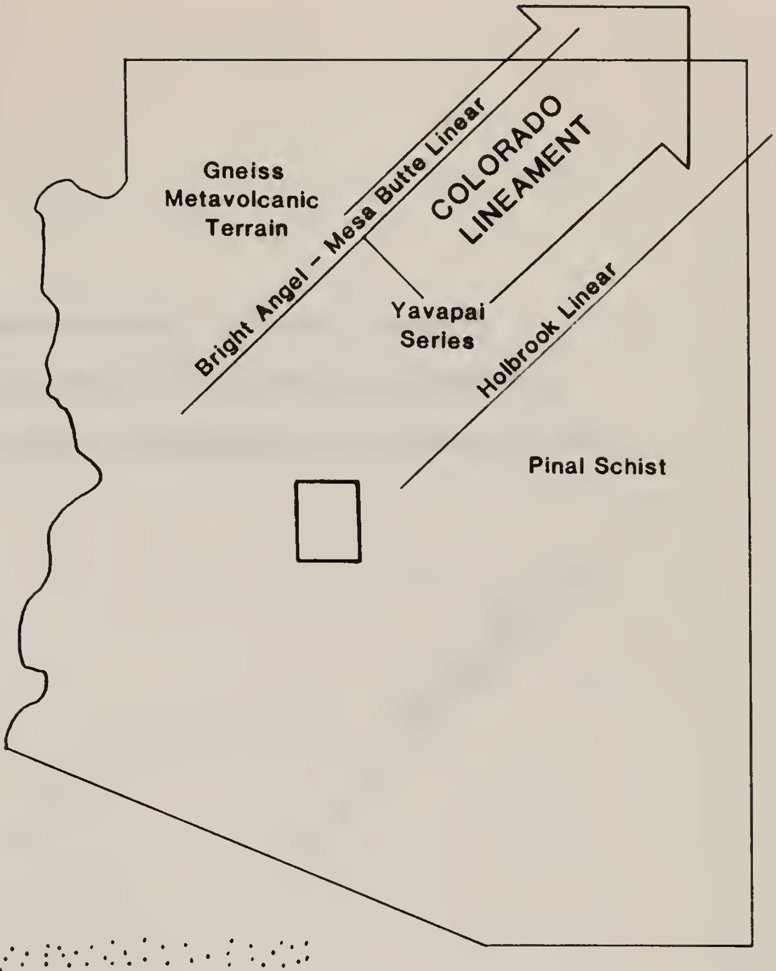


Figure 2A.

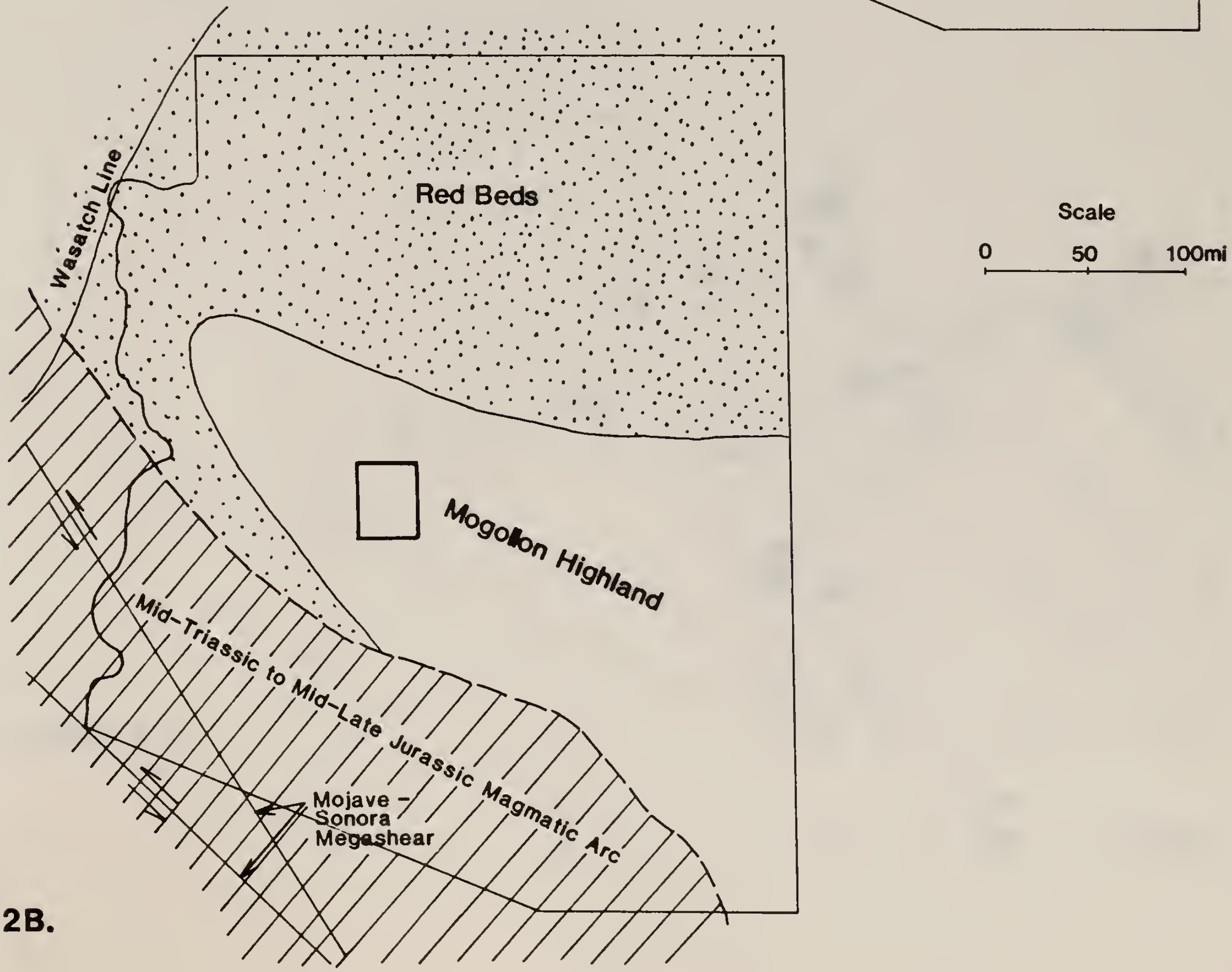


Figure 2B.

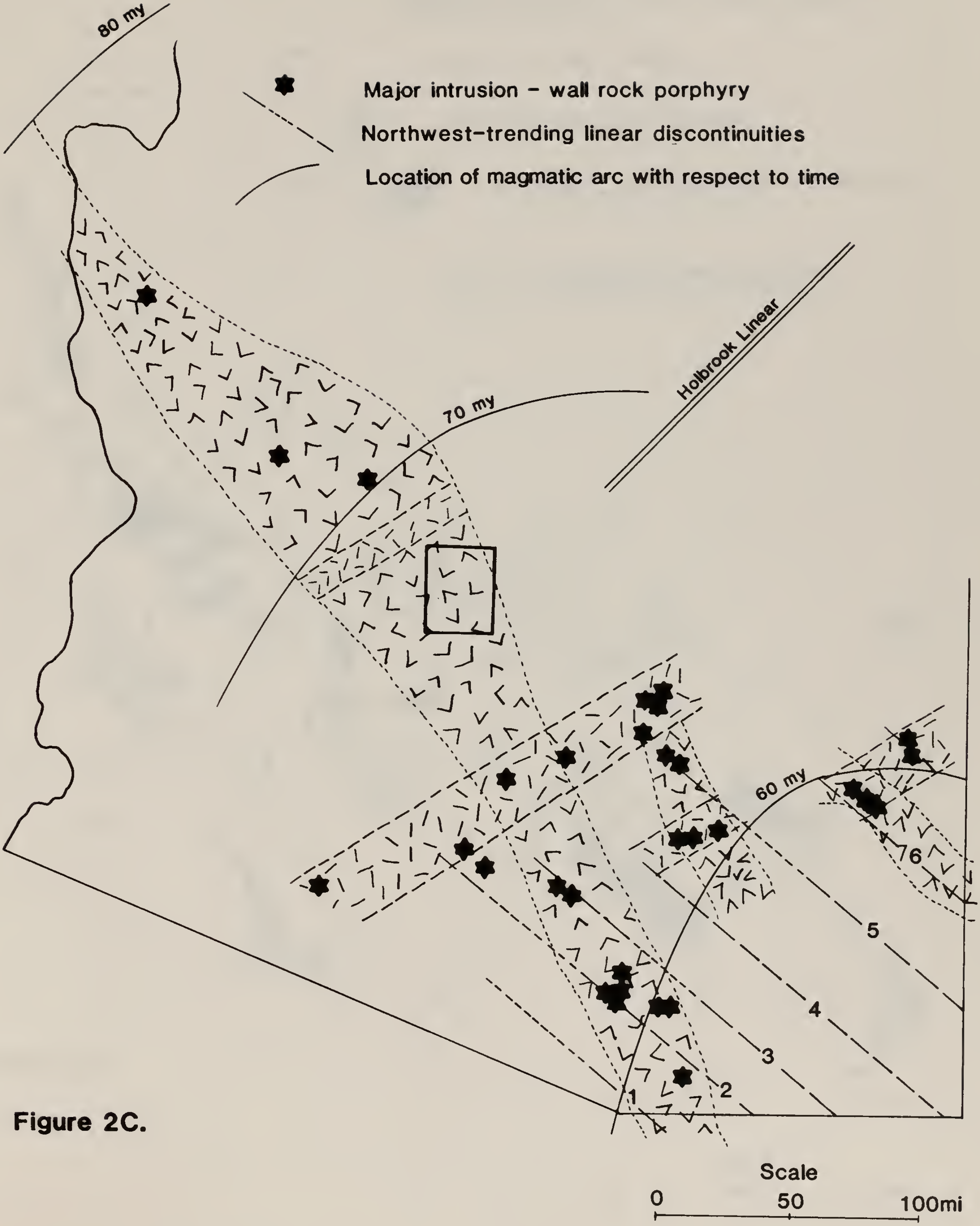

80 my
Major intrusion - wall rock porphyry
Northwest-trending linear discontinuities
Location of magmatic arc with respect to time
Holbrook Linear
70 my
60 my
1
2
3
4
5
6
Scale
0
50
100mi

Figure 2C.

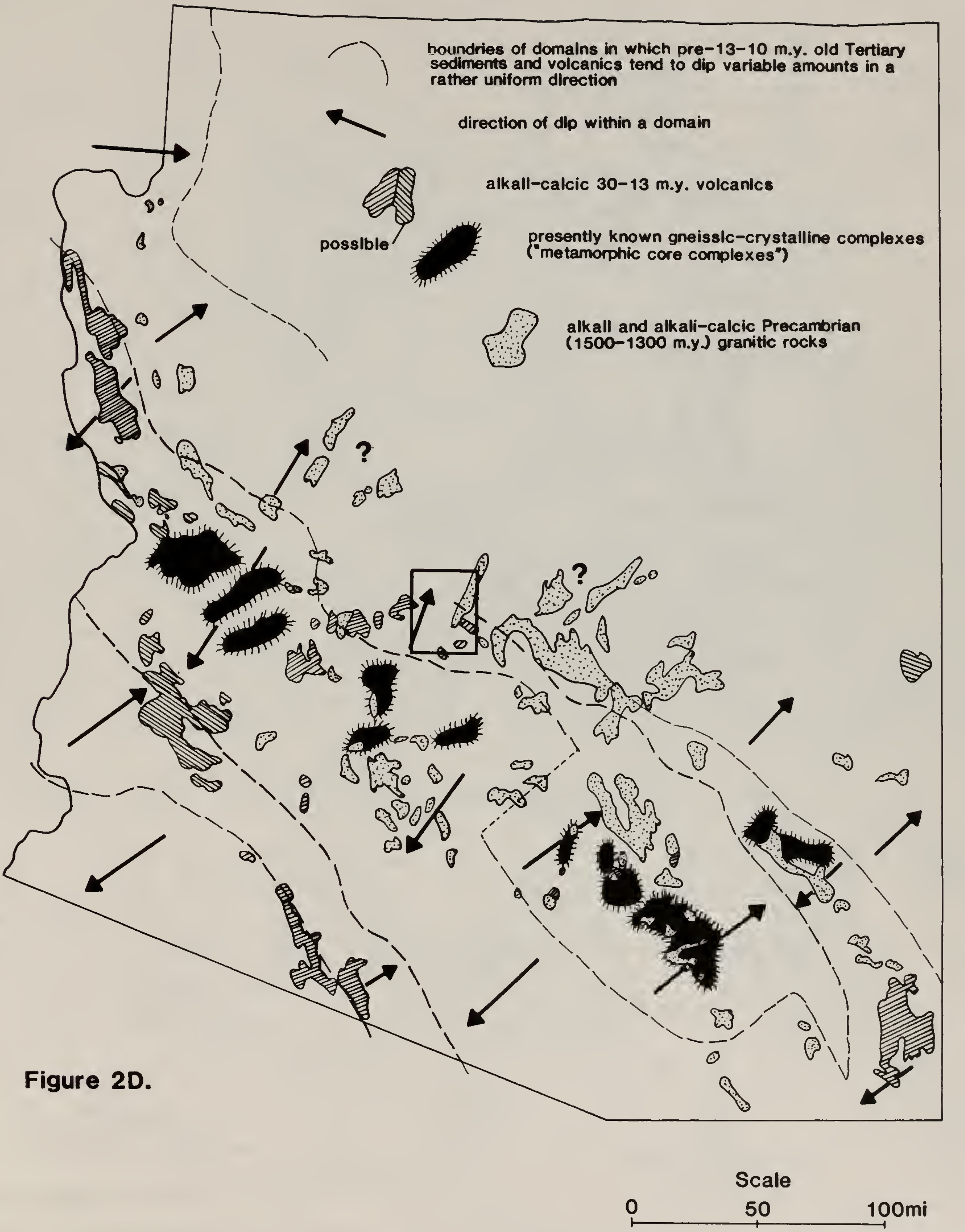

boundries of domains in which pre-13-10 m.y. old Tertiary sediments and volcanics tend to dip variable amounts in a rather uniform direction
direction of dip within a domain
alkali-calcic 30-13 m.y. volcanics
possible
presently known gneissic-crystalline complexes ("metamorphic core complexes")
alkali and alkali-calcic Precambrian (1500-1300 m.y.) granitic rocks
?
?
Scale
0
50
100mi

Figure 2D.

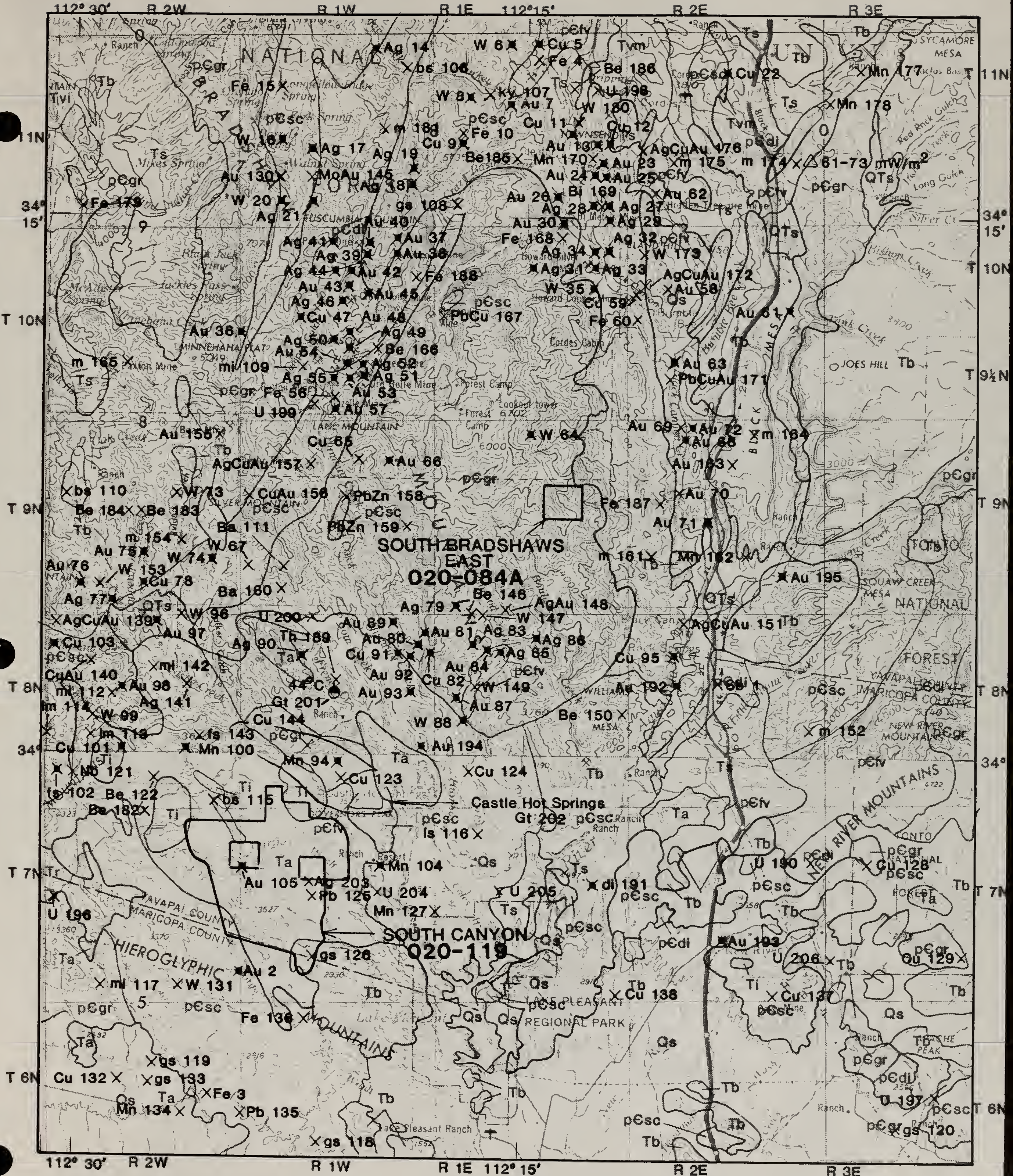


FIG. 3 GEOLOGIC, ENERGY AND MINERAL RESOURCES MAP OF THE HOT SPRINGS AREA, ARIZONA

Scale
1 : 250,000
LEGEND: see enclosed

Figure 4. LEGEND
FOR
GEOLOGIC, ENERGY AND MINERAL RESOURCES MAPS

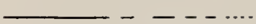
Scale of all maps is 1:250,000 or as otherwise indicated.

LITHOSTRATIGRAPHY

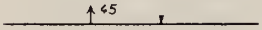
After Wilson, et al. (1969) with modifications from Donnelly and Hahn (1981), Reynolds (1980), Scarborough and Wilt (1979), Eberly and Stanley (1980).

QUATERNARY	Qs	Unconsolidated alluvial fan and floodplain deposits.
LATE TERTIARY TO QUATERNARY	QTs	Poorly consolidated fanglomerates and fluvial sands and gravels.
MID-TERTIARY	Ts	Conglomerates, sandstones, mudstones and minor limestones.
	Tb	Basaltic flows and breccias.
	Tr	Rhyolitic flows, tuffs and breccias.
	Ta	Andesitic flows, breccias and tuffs.
	Tvm	Flows, tuffs and breccias of mafic composition.
	Tvi	Flows, tuffs and breccias of intermediate composition. May include latites and trachytes.
	Ti	Small stocks, plugs, dikes, sills of rhyolitic to basaltic composition.
PRECAMBRIAN	pЄdi	Diorite porphyry intrusives.
	pЄgr	Granitic intrusives.
	pЄfv	Felsic volcanics.
	pЄsc	Schist.

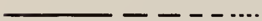
SPECIAL SYMBOLS
OF STRUCTURAL FEATURES
After U.S. Geological Survey



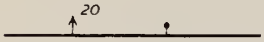
Contact – Dashed where approximately located; short dashed where inferred; dotted where concealed



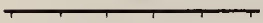
Contact – Showing dip; well exposed at triangle



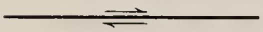
Fault – Dashed where approximately located; short dashed where inferred; dotted where concealed



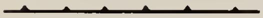
Fault, showing dip – Ball and bar on downthrown side



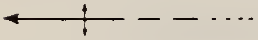
Normal fault – Hachured on downthrown side



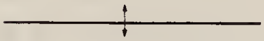
Fault – Showing relative horizontal movement



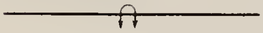
Thrust fault – Sawteeth on upper plate



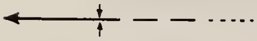
Anticline – Showing direction of plunge; dashed where approximately located; dotted where concealed



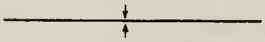
Asymmetric anticline – Short arrow indicates steeper limb



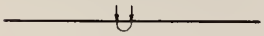
Overturned anticline – Showing direction of dip of limbs



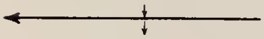
Syncline – Showing direction of plunge; dashed where approximately located; dotted where concealed



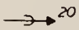
Asymmetric syncline – Short arrow indicates steeper limb



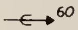
Overturned syncline – Showing direction of dip of limbs



Monocline – Showing direction of plunge of axis

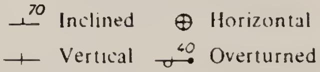


Minor anticline – Showing plunge of axis

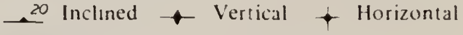


Minor syncline – Showing plunge of axis

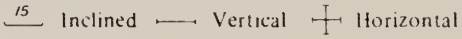
Strike and dip of beds – Ball indicates top of beds known from sedimentary structures



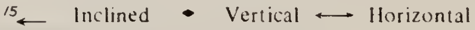
Strike and dip of foliation



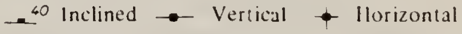
Strike and dip of cleavage



Bearing and plunge of lineation



Strike and dip of joints



Note: planar symbols (strike and dip of beds, foliation or schistosity, and cleavage) may be combined with linear symbols to record data observed at same locality by superimposed symbols at point of observation. Coexisting planar symbols are shown intersecting at point of observation.

SPECIAL SYMBOLS

FOR ENERGY AND MINERAL RESOURCES

KNOWN DEPOSITS AND OCCURRENCES

- ◯-O Oil field
- ◌-G Gas field
- ◯-Os Oil shale

- ⬢-C Coal deposit
- ⬡-C Coal occurrence

- ■-Mineral orebody - as specified with symbol
- ◨-Mineral deposit - as specified with symbol
- □-Mineral occurrence - as specified with symbol
- ▭-Mineral district (Fig.= inserted map)

EXPLORATION AND/OR MINING ACTIVITY

MINERALS AND COAL

- ✖ Mineral deposit, mine or prospect with recorded prod.
- × Prospect or mine with no recorded production
- ≻— Accessible adit, or tunnel
- ≻+— Inaccessible adit, or tunnel

- ◪ Vertical shaft
- ◪ Inclined shaft
- ⚒ Active open pit, or quarry
- ⚒ Inactive open pit, or quarry

- ✕ Active gravel or clay (cl) pit
- ✕ Inactive gravel or clay (cl) pit
- ⊕ Exploration hole with data available
- ⊗ Exploration hole without data
- ⊠ Mining district (Fig.= inserted map)

PETROLEUM

- ● Oil well
- ✹ Oil and gas well
- ☼ Gas well

- ☼ Show of gas
- ◑ Show of oil
- ◑ Show of oil and gas
- ○ Shut-in well

- ⊙ CO_2- or He-helium- rich well
- -○- Dry well - abandoned

GROUND WATER

- ○ Water well of special importance
- ○ Water well of high yield
- ○ Flowing water well

- ⊖ Brine
- ◑ Mineral water

- ◓ Thermal water
- ⊗ Radioactive water
- ▲ Thermal point

ENERGY RESOURCES

O	Oil
G	Gas
Os	Oil shale
Ot	Tar sands
C	Coal
Cb	Lignite (brown coal)
Cp	Peat
U	Uranium
Th	Thorium
Gt	Geothermal

MINERAL RESOURCES

METALS

Al Aluminum
Sb Antimony
As Arsenic
Be Beryllium
Bi Bismuth
Cd Cadmium
Cr Chromium
Cs Cesium
Co Cobalt

Cu Copper
Ga Gallium
Ge Germanium
Au Gold
Fe Iron
Pb Lead
Li Lithium
Mn Manganese
Hg Mercury

Mo Molybdenum
Ni Nickel
Nb Niobium or Columbium
Pt Platinum group
RE Rare earth
Re Rhenium
Sc Scandium
Ag Silver
Te Tellurium

Tl Thallium
Sn Tin
Ti Titanium
W Tungsten
V Vanadium
Zn Zinc
Zr Zirconium and
  Hf Hafnium

NONMETALS - INDUSTRIAL MINERALS

ab Abrasives
al Alum
as Asbestos
Ba Barite
be Bentonite
ca Calcite
cl Clay

Construction materials :
  cs Crushed stone
  la Lightweight aggregates, includ.:
    pm Pumice and volcanic cinders
    pe Perlite
    ec Expanded clay, shale, slate
    vm Vermiculite
  sg Sand and gravel
  cr Cement raw materials
  bs Building stones
  li Lime

di Diatomite

Nonmarine and marine evaporites and brines
  pt Potash
  na Salt - mainly halite
  gy Gypsum and anhydrite
  nc Sodium carbonate or sulfate
  bn Boron minerals
  ni Nitrates
  Sr Strontium
  Br Bromine
  cc Calcium chloride
  mg Magnesium compounds

fs Feldspar
F Fluorite (fluorspar)
gs Gem stones
ge Graphite
He Helium
kl Kaolin
ky Kyanite and related minerals
ls Limestone
lm Lithium minerals

mg Magnesian refractories
mi Mica
ph Phosphate
pi Pigment and fillers
qz Quartz crystals
si Silica sand
S Sulfur
tc Talc
ze Zeolites
hm Humate

SPECIAL GEOLOGICAL FEATURES

POINT OF SPECIAL GEOLOGIC INTEREST

- m Mineral occurrence
- f Fossil locality
- v Volcanic phenomenon
- t Stratigraphic sequence
- s Structural, bedding, foliation, etc.,
- b Brecciation, shear zone, etc.,
- y High yield spring
- p Spring with mineral water
- u Radioactive spring
- g Thermal spring
- a Extensive rock alteration
- r Lithologic type locality

FAVORABILITY POTENTIAL AND LEVEL OF CONFIDENCE FOR MINERAL RESOURCES

FAVORABILITY:

1A - Undefined
1 - Not favorable - combine with either B, C, or D
2 - Low
3 - Moderate
4 - High

(2, 3, 4) combine with either A, B, C, or D

LEVEL OF CONFIDENCE:

A - Insufficient data
B - Indirect evidence
C - Direct evidence
D - Abundant direct and indirect evidence

craton from the southeast. The northwestern of these belts consists of gneisses which are in part metavolcanic, were deposited about 1.8 b.y.B.P. (Titley, 1982), and have been metamorphosed to the amphibolite facies. The central belt consists of the Yavapai Series which were deposited 1.82-1.775 b.y.B.P. (Anderson and Silver, 1976). According to Anderson and Silver (1976) and Titley (1982) this is a greenstone belt which is some 40,000 feet thick. The southeastern belt consists of the Pinal Schist which was deposited 1.7-1.6 b.y.B.P. (Silver, 1978) and consists of quartz, muscovite schist, arkose and quartzite (Titley, 1982). These Older Precambrian rocks were metamorphosed and intruded by granites during the Arizonan Revolution 1.76-1.63 b.y.B.P. (Damon, 11958), and were intruded by anoregenic granites 1.5-1.4 b.y.B.P. (Silver et al., 1977).

The Hot Springs GRA lies entirely within the central belt of the Yavapai Series which have been extensively intruded by Precambrian granites. The geology of the Yavapai Series in central Arizona has recently been summarized by Donnelly and Hahn (1981). Within the GRA they provide stratigraphic information on the north-central part of the GRA (the Cleater Belt); on the north-south striking belt east of center in the GRA (the Black Canyon Belt); and on the southeastern part of the GRA (the New River District). The proportions of various rock types in each of the above three areas is summarized in Table 2.

Table 2. Approximate Proportions of Various Rock Types Present in the Yavapai Series, Hot Springs GRA

Rock Type	Cleator	Black Canyon	New River
Epiclastic fine and coarse-grained sediments	0.55	0.70	0.20
Undifferentiated volcanoclastics	0.05	0.15	0.25
Exhalites of oxide, carbonate and sulfide iron formation, chert, and massive sulfides	0.06	0.03	0.02
Sub-aerial rhyolite volcanic complex	0.00	0.00	0.24
Felsic to intermediate tuffs	0.14	0.06	0.05
Mafic to intermediate tuffs and lavas	0.20	0.06	0.24

Within the Yavapai Series in general, volcanism tends to follow cycles from mafic to intermediate to felsic followed by deposition of sediments. The exhalites typically occur on top of, or on the flanks of a rhyolitic volcanic center or in the immediately overlying sediments (Anderson and Nash, 1972; Anderson and Guilbert, 1979; Donnelly and Hahn, 1981). The metavolcanic rocks have undergone two periods of folding and are generally in the greenschist facies. They have been altered to chlorite-rich rock near massive sulfide deposits (Anderson and Nash, 1972).

Precambrian granites are widespread throughout the GRA and they intrude the Yavapai Series. They range in composition from quartz monzonite to granodiorite, and in the Cleator and Jerome areas were intruded 1.77 b.y.B.P. (Donnelly and Hahn, 1981). Elsewhere in central Arizona batholiths were emplaced 1.77-1.72; 1.70-1.65 and 1.5-1.4 b.y.B.P. (Silver et al., 1977; Donnelly and Hahn, 1981). The latest Precambrian granitic intrusions (1.5-1.4 b.y.B.P.) are anorogenic calc-alkaline to alkaline rapakivi granodiorite to

granite plutons that extend along a northeasterly-striking zone from southeastern California to Labrador (Silver et al., 1977). According to Scarborough and Wilt (1979, p. 88; see fig. 2D) none of the 1.5-1.4 b.y.B.P. plutons are present within the GRA.

Younger Precambrian

Younger Precambrian sediments including the Pioneer Formation, Dripping Springs Quartzite and the Mescal Limestone (Apache Group) crop out to the southeast (Wilson, 1962) but do not crop out in the GRA nor to the south, north or west of the GRA. Apparently this region was an upland at this time and no sedimentation took place. Intruded into the Apache Group sediments are diabase sills which, according to Damon (1968) and Silver et al. (1977) were intruded 1.2 to 1.1 b.y.B.P. In the Hot Springs GRA diorite porphyries, diorites and gabbros intrude Precambrian Yavapai Series and Precambrian granitic rocks and could be correlative of the diabase.

Paleozoic

Paleozoic sedimentary rocks in Arizona range in age from Cambrian to Permian and consist mainly of quartzite, dolomite and limestone. They consist of Bolsa Quartzite, Abrigo Formation, Martin Formation, Escabrosa Limestone, Supai Formation, Coconino Sandstone and Kaibab Limestone or their stratigraphic equivalents (Wilson, 1962). The sediments were laid down in a shelf environment, to the east of the Cordilleran geosyncline (see fig. 2B) from which they are separated by the Wasatch line (Burchfiel, 1979). No Paleozoic sediments crop out within the GRA, which at the time formed a positive area known as Mazatzal Land (Wilson, 1962). Paleozoic sediments were thus probably never deposited in the area covered by the GRA.

Mesozoic Rocks

Mesozoic continental red-beds are present in the northern and western Arizona (see fig. 2B). The central part of Arizona, including the area covered by the GRA constituted the Mogollon Highlands in which no sediments were deposited. The Mesozoic magmatic arc cut across southwestern Arizona (see fig. 2B) but apparently did not affect the area covered by the GRA.

Laramide Orogenic Period

The Laramide was a period of volcanism intrusion and intense tectonic activity in southern Arizona. It is of particular importance because a large number of porphyry copper deposits were formed at this time, especially in southeastern Arizona (see, for instance, Damon and Manger, 1966; Shafiqullah et al., 1980; Titley, 1981; Heidrich and Titley, 1982; and Fig. 2 of this report). The magmatic and tectonic activity took place during the southeastward sweep of the magmatic arc, possibly as a result of the decrease in the dip of the Benioff zone at this time (Coney and Reynolds, 1977; Clark et al., 1982).

The Hot Springs GRA lies within a northwest-striking Laramide arc (see fig. 2C), however, no known Laramide intrusions are large enough to show on the 1:250,000 scale map.

Metamorphic Core Complexes

Metamorphic core complexes occur along a northwest-striking zone extending from southeastern to west-central Arizona (see fig. 2D). Their general features have been summarized by Reynolds (1980) as follows: Amphibolite grade metamorphic rocks are overlain by gently-dipping mylonitic rocks which define a broad dome and grade upward into a chloritic breccia. This gradation represents a sharp thermal and strain gradient. A sharp dislocation

plane separates the breccia from allochthonous, but unmetamorphosed, rocks which have been affected by listric normal faulting. The core complexes typically record 30-20 m.y.B.P. cooling ages and were probably emplaced during the fast regression of the magmatic arc 40-20 m.y.B.P. (Coney and Reynolds, 1977), a time at which voluminous volcanism was taking place in southern Arizona.

No metamorphic core complexes lie within the GRA, but the White Tank Mountains metamorphic core complex (see Rehrig and Reynolds, 1980) lies only about 10 miles south of the GRA. It could underlie some of the Tertiary sediments in the southern part of the GRA.

Mid-Tertiary Rocks

Mid-Tertiary rocks are here defined to include all sedimentary and igneous rocks deposited after the Laramide orogeny and the post-Laramide period of peneplanation, and before Basin and Range-type faulting became dominant. These pre-Basin and Range rocks have been divided into three units by Eberly and Stanley (1978) and Scarborough and Wilt (1979).

The lowest unit consists of indurated brown arkosic fluvial sandstone, fanglomerates of gneissic and granitic provenance up to 300 feet thick, and minor lacustrian sediments with some algal limestone. Andesitic to rhyolitic volcanics increase in abundance toward the upper part of this unit.

The middle unit is characterized by voluminous intermediate to felsic volcanism that is associated with the mid-Tertiary orogeny. The volcanics consist of flows, ash flow tuffs, tuff breccias and ash of latitic, quartz latitic, rhyolitic and trachytic composition, and flows and flow breccias of basaltic, basaltic andesite and andesitic composition (Reynolds, 1980). Small intrusions of the above compositions are also present. The volcanic rocks are interbedded with red sand and gavel fluvial deposits, massive

fanglomerates and lacustrine deposits with local organic-rich facies, algal limestones and water-laid tuffs. It is within such beds that the well-known Anderson uranium mine is located (Sherborne et al., 1979).

The upper unit consists of grayish brown poorly consolidated sandstones, fanglomerates, mudstone and water-laid tuffs. The rocks contain abundant volcanic debris. They are overlain and intercalated with basaltic volcanics. Mudstones in lacustrine deposits contain freshwater ostracods.

The mid-Tertiary rocks rest unconformably on Precambrian, Paleozoic, Mesozoic and Laramide rocks. They were deposited in northwest-striking basins which were tilted northeastward and southwestward as shown in figure 2D (Scarborough and Wilt, 1979).

The mid-Tertiary rocks may underlie the valleys at the southern end of the GRA. They are present to the south of the GRA in the Phoenix basin (see Eberly and Stanley, 1978), where approximately 1000 feet of mid-Tertiary sediments are present. Tertiary sediments crop out in south, north-central and northwestern part of the GRA. They have been examined in the southern part of the GRA by Scarborough and Wilt (1979) at Lake Pleasant, New River Mesa and New River. Here they consist of calcareous mudstones, limestone and dolomites, red lithic tuffs, rhyolitic air-fall deposits, agglomerates, ash-flow tuffs, andesite flows and breccias. They ave been dated at 26.5-21.3 m.y.B.P. They rest unconformably on Precambrian and are overlain unconformably by a basalt dominated sequence (see later section).

The unit shown on the map as Ta is also part of the mid-Tertiary sequence. Scarborough and Wilt (1979) indicate that it is alkali-calcic in nature and was deposited 30-13 m.y.B.P. It consists of andesitic flows and tuffs (Wilson et al., 1969) but also contains dacite rhyolite and felsic tuffs (U.S.G.S., 1981). The mid-Tertiary rocks in the Hot Springs GRA are thus

dominated by intermediate to felsic volcanics and can thus probably be correlated with the middle unit of Eberly and Stanley (1978).

Late Tertiary

Late Tertiary deposits are found in all the tectonic basins formed during the Basin and Range disturbance. The deposits consist mainly of poorly consolidated, tan-colored fanglomerate sandstone and siltstone of fluvial and lacustrine origin and lesser basaltic volcanics (Scarborough and Wilt, 1979; Reynolds, 1980). In the Phoenix basin to the south of the GRA Late Tertiary sediments are up to 11,000 feet thick and contain up to 8000 feet of halite-bearing evaporite beds (Eberly and Stanley, 1978). The Late Tertiary deposits rest unconformably on mid-Tertiary rocks and were deposited after the transition from the mid-Tertiary orogeny to the Basin and Range disturbance. According to Shafiqullah et al. (1981) this transition took place sometime between 19-12 m.y.B.P., depending on the location within southern Arizona.

Late Tertiary deposits have been examined in the southern part of the GRA by Scarborough and Wilt (1979), at Lake Pleasant and New River Mesa. They consist of fluvial sands and muds, reworked basaltic tuffs and channel-fill conglomerate interlayered with basaltic flows. The basalt flows range in age from 16.6 to 13 m.y.B.P. The Late Tertiary deposits rest unconformably on the mid-Tertiary rocks and are probably related to Basin and Range faulting.

Latest Tertiary and Quaternary

During the last 9 m.y. volcanic activity and tectonism have slowed down (Shafiqullah et al., 1981) and during the last 4 my the dominant geological procession in the Basin and Range Province have been erosion of mountain ranges, formation of extensive pediments, deposition of fanglomerates and deposition of alluvium along the major rivers.

Pediment surfaces have formed and fans have been deposited in the southern part of the GRA facing the Phoenix basin. River alluvium has been deposited along the Agua Fria River and its tributaries.

Structural Geology

The GRA lies within the North American craton, east of the Wasatch line (see fig. 2A) and close to the boundary between the Colorado Plateau and the Basin and Range Province. It has been affected by tectonism during the Proterozoic, Laramide and mid-Tertiary orogenies, and most recently by the Basin and Range disturbance.

During the Arizonan Revolution 1.76 to 1.65 b.y.B.P. according to Damon (1968), the Precambrian rocks were folded about ENE striking axes and underwent N-S to NNW faulting (Davis, 1981). The Colorado Lineament (see fig. 2A), a major strike-slip fault, was initiated about this time according to Warner (1978).

No pronounced tectonic or igneous activity took place during the Paleozoic. During the Mesozoic southwestern Arizona was strongly affected by a mid-Mesozoic magmatic arc and a later period of metamorphism and folding, but the effects of these apparently did not reach the area covered by the GRA.

The Laramide was a period of intense tectonism and localized magmatic activity which was associated with the southeastward migration of the magmatic arc (Coney and Reynold, 1977; Lowell, 1974). Probably related to ENE plate motion and compression are basement-cored uplifts and thrust faults which strike NNW to NW (Nielsen, 1979; Davis, 1981); WNW left lateral strike slip faulting of the Texas zone of Schmitt (1966); and the ENE-striking tensional features (Rehrig and Heidrick, 1976). Laramide plutons associated with porphyry copper mineralization have a pronounced NNW to NW trend and a

secondary ENE trend (Heidrick and Titley, 1982; see also fig. 2C this report). The former is parallel to the Laramide magmatic arc and the trend of the basement-cored uplifts and the latter is parallel to Precambrian fold axes and Laramide tensional features. The most pronounced Laramide tectonism and magmatic activity lies to the south of the GRA but a NW and an ENE trend of mineralized Laramide plutons intersects in the northern part of the GRA (see fig. 2C).

The mid-Tertiary orogeny lasted approximately from 34 to 14 m.y.B.P. (Shafiqullah et al., 1980) and involved eruption of large volumes of volcanics, emplacement of metamorphic core complexes and listric normal faulting. These geologic events accompanied the westward migration of the magmatic arc, possibly as a result of the steepening of the Benioff zone at this time (Coney and Reynolds, 1977). In southern and southwestern Arizona enormous volumes of ignimbrites were erupted. In the Hot Springs GRA the andesites and associated more felsic rocks were erupted at this time. Metamorphic core complexes and listric normal faulting are not known to be present in the GRA.

Between 19 and 12 m.y.B.P. a transition occurred between the mid-Tertiary orogeny and Basin and Range faulting. In the Hot Spring GRA this transition appears to have been between about 21 and 16 m.y.B.P. The Basin and Range faults strike NW to N-S and are high angle faults (Davis, 1981). The present-day ranges and basins result from this tectonic episode. Within the GRA structural depressions filled with Late Tertiary sediments formed at this time, as was the Phoenix Basin to the south of the GRA. The Basin and Range tectonic episode was terminated about 4 m.y.B.P. (Shafiqullah et al., 1980).

Geologic History

The geologic history of central Arizona is long and complex and only a brief synopsis is presented here. Excellent summaries of the main geological

events that affected the southern part of the North American Cordillera are given by Burchfiel (1979) and Dickinson (1981). More detailed accounts pertaining particularly to southwestern Arizona are given by Shafiqullah et al. (1980) and Reynolds (1980). The geologic history can be summarized as follows:

1. Volcanic and clastic rocks of the Yavapai Series were accreted onto the North American continent from the southeast 1.8-1.7 b.y.B.P. (Anderson, 1976; Anderson and Silver, 1976; Silver, 1978; Titley, 1982). The rocks were folded about northeasterly axes, metamorphosed to the greenschist facies and intruded by granitic batholiths during the Arizonan Revolution about 1.7-1.6 b.y.B.P. (Damon, 1968). Areas outside the GRA were intruded by anorogenic granites 1.5 to 1.4 b.y.B.P. (Silver et al., 1977).
2. Sometime after this the area was uplifted and eroded. To the east of the GRA the land was submerged beneath epicontinental seas and shallow marine clastic sediments and carbonates of the Late Proterozoic Apache Group were deposited. These were intruded by diabase sills 1.1 to 1.2 b.y.B.P. The area covered by the GRA remained above sea level at this time. Mafic intrusions in the area may be related to the diabase sills.
3. During the Paleozoic a clastic and carbonate shelf sequence was deposited over much of Arizona. The area covered by the GRA remained an upland (Mazatzal Land) during much of this time, and no Paleozoic sediments were deposited there (Wilson, 1962).

4. During the Mesozoic, continental red beds were deposited to the north of the GRA (Dickinson, 1981), and in southwestern Arizona a magmatic arc developed and was followed by a period of folding and metamorphism (Reynolds, 1981). The area covered by the GRA remained an upland (Mogollon Highlands) (Dickinson, 1981) and apparently was not affected by the above events.
5. The Laramide was a period of intense tectonic activity in southern Arizona. It was characterized by tectonism resulting from compression in the northeast-southwest direction (Davis, 1981) and intrusion of epizonal granitic plutons along NW and ENE trends (Heidrick and Titley, 1982). Two of these trends, which are related to porphyry copper mineralization, intersect in the northern part of the GRA (see fig. 2C).
6. The mid-Tertiary orogeny lasted from about 35-14 m.y.B.P. in southern Arizona. During this time a great thickness of fluvial and lacustrine sediments and felsic to intermediate volcanics were deposited in northwest-striking basins, metamorphic core complexes were emplaced (see fig. 2D), and the area was affected by listric normal faulting (Eberly and Stanley, 1978; Scarborough and Wilt, 1979; Shafiqullah et al., 1980; Davis, 1981). Mid-Tertiary intermediate to felsic volcanics are present in the southern part of the GRA, but the effects of metamorphic core emplacement and listric normal faulting are not evident there.
7. Between 19 and 12 m.y.B.P. the mid-Tertiary orogeny subsided and a transition into Basin and Range steep normal faulting took place (Shafiqullah et al., 1980). Within the GRA this

transition probably took place between 20 and 16 m.y.B.P. The Basin and Range faulting was accompanied by thick accumulation of fluvial and lacustrine sediments in the basins and eruption of basaltic volcanics. Within the GRA basalts and interlayered tuffaceous sediments were deposited at this time.

8. During the last 9 m.y. volcanism and tectonism have subided (Shafiqullah et al., 1980) and the dominant geological processes have been erosion and deposition of alluvium.

Paleontology

Paleontological documentation is important for three major reasons, as follows:

a. guide fossils, which in the sedimentary sequence are most useful for stratigraphic correlation,

b. outstanding fossil specimens or fossils which are extraordinarily preserved can be beneficial to science and/or tourism, and

c. fossils can be excellent indicators of the paleogeographic and paleoecological environments; as a result, even moderately to poorly preserved, "uninteresting" fossils can be important geologically.

Plant fossils must also be considered important as organic material can trigger the precipitation of uranium and other metals.

To the authors´ knowledge, there are no fossil localities of outstanding importance or interest within the Hot Springs GRA. The South Canyon (020-119) WSA is underlain by Tertiary igneous rocks, and no fossils have been reported from these rocks. Tuffaceous sediments interbedded with the volcanics may

contain some fossils. The South Bradshaws East (020-084A) WSA is entirely underlain by Precambrian granite and thus no fossils are expected to occur in the WSA.

ENERGY AND MINERAL RESOURCES

The following are descriptions of known mineral deposits, prospects, occurrences, mineralized areas, and thermal wells and other energy resources (fig. 3) of the Hot Springs GRA. Information was derived from the following sources: U.S. Geological Survey (1982, 1972), Johnson (1972), Arizona Bureau of Mines (1969), Stipp et al. (1967), McCrory and O´Haire (1965) and other references previously mentioned in the text. The descriptions represent a summary of the information regarding individual occurrences that is available to the authors. Figure 3 shows locations of the mines, mineral occurrences and geothermal wells and areas listed below.

An area (T. 10 and 11 N., R. 1E., approximately) in the northern part of the GRA is unsurveyed and is bordered by two different PLS grid systems. Locations given in the following descriptions have been altered from USGS Crib locations, as necessary, to reflect just one grid system; arbitrarily chosen was the grid that covers the western part of the GRA.

Known Mineral Deposits, Mines or Prospects with Recorded Production

2. Morgan Wash
   Synonym Name: Morgan City Mine (?)
   Location: Latitude 33°54´8"N, 112°23´43"W
   Sec. 31, T7N-R1W, Sec. 6, T6N, R1W
   Commodity: Au
   Deposit Description: Placer deposit surface workings
   Production: Yes, small amount, 1939-41, and 1948
   References: USGS, 1980, CRIB Mineral Resources File, Record 852, p. 2275-2276; USGS Bull 1355, 1972.

5. Blue Bell Mine
Location: 34°20´24"N, 112°14´31"W
Sec. 15, T11N-R1E
Commodities: Cu, Ag, Au, Pb, Zn, As (Cu main comm) (Ag, Au minor)
Ore Materials: Pyrite, Chalcopyrite, Tetrahedrite, gold, bornite, chalcocite, arsenopyrite, sphalerite, galena.
Deposit Description: Stratiform massive sulfide, lens shaped. Small deposit, depth to bottom of deposit 1800´, 1600 feet in length, 1800 feet in width, 100 feet maximum thickness, orebody strike N27W, and dips 70°SW. Extensive underground workings.
Geology: Mineralization in Precambrian metarhyolite, chert, andesitictuff. Deposit is a number of slightly overlapping massive sulfide lenses at or near a rhyolite-andesite contact.
Production: Yes, small production, 67,000 lbs Cu between 1896-1926, Au 42 ounces 1903-1925, 1298 ounces Ag 1903-1925.
References: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2425, p. 6086-6089, Stipp et. all., 1967.

6. What-A-Pal Prospect
Location: SE 1/4 of SE 1/4 Sec. 16, T11N, R1E.
Commodity: W
Deposit Description: Veins, stringers, grains. Small deposit, 200 feet in length, 1 foot maximum width. The ore body strike N15E and dips 52° NW. Stringers and grains 2 inches wide. Surface workings.
Geology: Precambrian Yavapai schist, Tertiary mineralization.
Production: Small amount, 1953.
References: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2426, p. 6090-6092.

7. Mohawk Mine
Location: 34°15´56"N, 112°21´59"W
Sec. 28 T11N, R1E.
Commodity: Au
Ore Material: Free gold
Deposit Description: Small veins, underground workings
Geology: Mineralization in Precambrian granodiorite (Brady Butte) with quartz and barite, controlled by faulting and shearing. Mineralization Cretaceous-Tertiary.
Production: Yes, 480 ounces, 1936.
Reference: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2427, p. 6093-6095.
Note: Longitude listed is from USGS CRIB and does not match PLS location given, also from CRIB. Mine location shown in figure was located using PLS listing.

8. North Star and Money Maker Prospect
Location: NW 1/4 sec. 29, T11N, R1E
Commodity: W
Ore Material: Scheelite
Deposit Description: Veins, small deposit. Area 4 miles long and 1 mile wide, striking N40E. Sporadic scheelite deposits found over maximum area of ore body. Surface workings.
Geology: Host Rock Precambrian Yavapai Schist.
Production: Yes, small amount.
Reference: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2428, p. 6096-6098.

9. DeSoto Mine
Location: 34°17′28"N, 112°17′27"W
Sec. 31,32, T11N, R1E
Commodities: Cu (major product); Au, Ag, Pb, Zn (minor product).
Ore Materials: Pyrite, chalcopyrite, sphalerite, galena, tetrahedrite, ansenopyrite, gold.
Deposit Description: Stratiform massive sulfide, lens shaped, small deposit, 350 feet in length, 200 feet in width, striking N23E, and dipping 70°NW.
Geology: Underground workings. Mineralization in Precambrian metarhyolite, chert, meta-andesite tuff.
Production: Yes, small production.
References: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2429, p. 6099-6101 Stipp et. al., 1967; Anderson and Guilbert, 1979.

11. Rainbow Mine
Synonym Name: Rainbow Prospect, Rainbow Group
Location: 34°16′46"N, 112°-14′19"W
Sec. 35, T11N, R1E
Commodities: Cu (major); Fe, Ag, Au (minor)
Ore Materials: Pyrite, pyrrhotite, chalcopyrite
Deposit Description: Vein deposit, small tabular deposit with a maximum width of 200 feet. Underground workings.
Geology: Mineralization in Precambrian quartz-mica schist and chert, associated with Precambrian granite. Mineralization controlled by faulting and shearing.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2431, p. 6104-6106, Stipp et. al., 1967

12. Great Republic Mine
Location: 34°16′57"N, 112°-11′56"W
SE 1/4 of SE 1/4 sec. 36, T11N, R1E

Commodities: Cu, Ag, Au
Ore Materials: Chalcopyrite, auriferous pyrite
Deposit Description: Stratiform massive sulfides in lenses, underground workings.
Geology: Mineralization in Precambrian metarhyolite, dacite.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2432, p. 6107-6109.

13. Parker Prospect
Synonym Name: Parker Claim
Location: NE 1/4 NE 1/4 sec. 36, T11N, R1E
Commodities: Au, Ag (major); Cu, Pb (minor)
Deposit Description: Veins, deposit tabular, 100 feet in length, 3 inches wide, underground workings.
Geology: Host rock Precambrian metarhyolite, andesite, amphibolite, Tertiary diorite, basalt. Ore control faulting and shearing.
Production: Yes, small amount, averaging 1 oz. Au/T, 5 oz. Ag/T.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2433, p. 6110-6112.

14. Morgan Mine
Location: 34°20´10"N, 112°20´22" W
Sec. 2, T11N, R1W
Commodities: Ag, Au, Pb, Zn
Ore Materials: Ruby silver, galena, sphalerite, little pyrite
Deposit Description: Vein, small ore, body striking N20E, and dipping 53°NW. Surface and underground workings.
Geology: Host rock: granodiorite, quartz mica schist, felsite prophyry. Ore controlled by faulting. Quartz vein containing mineralization localized along contact with granodiorite.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2434, p. 6113-6115.
Note: Area has not been surveyed by the PLS System; section, township and range are extrapolated from surveyed areas to the west.

16. Mammoth Prospect
Location: 34°16´52"N, 112°23´10"W
Sec. 20, T11N, R1W (Approx. Loc.)
Commodity: W
Ore Material: Scheelite
Deposit Description: Vein deposit, striking N5°W and dipping to 70°W.
Geology: Mineralization in Precambrian Yavapai schist.
Production: Yes, small amount.
References: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2436, p. 6118-6119; Stipp et. al., 1967.

17. Tuscumbia Mine
Synonym Name: Tusculum Deposit
Location: 34°16´41"N, 112°22´10"W
Sec. 21, T11N, R1W
Commodities: Ag, Cu (major); Pb, Zn (potential)
Ore Materials: Silver, silver chlorite, galena, sphalerite
Deposit Description: Tabular veins, small deposit, 1000 feet in length, 200 feet in width, striking N50°W. Underground workings.
Geology: Mineralization in Precambrian granodiorite, veining probably Cretaceous - Tertiary age. Ore controlled by faulting and shearing.
Production: Yes, small amount.
References: USGS, 1981, CRIB Mineral Resources File 12, Record 2437, p. 6120-6122; Stipp et. al., 1967.

18. Swastika Mine
Synonym Name: Silver Prince, Black Warrior, Mora B, King Don
Location: 34°15´44"N, 112°18´40"W
SE 1/4 SE 1/4 sec. 25, T11N-R1W
Commodities: Ag, Pb (major); Cu, Au (minor); Zn (potential)
Ore Materials: Silver, cerargyrite, silver chloride, silver bromide, tetrahedrite, argentiferous galena, chalcopyrite.
Deposit Description: Tabular veins, in small area, 3000 feet in length, 700 feet in width, 10 feet in thickness, striking N25°E, and dipping 70°W. Underground workings.
Geology: Veins in Precambrian chert and schist, veins best developed in chert, the veins are associated with rhyolitic dikes of Cretaceous or Tertiary age, but the ore is not localized in dikes.
Production: Yes, small amount.
References: USGS, 1981, CRIB Mineral Resources. File 12, Record 2438, p. 6123-6126; Anderson and Gilbert, 1979.

19. Peck Mine
Location: Sec. 25, T11N, R1W
Commodities: Ag (major); Cu, Pb, Au (minor); Zn (potential); As (occurrence)
Ore Materials: Cerargyrite, bromyrite
Deposit Description: Vein deposit, small, striking N25°E and dipping 75°NW, 3 veins worked underground.
Geology: Veins cut Precambrian metachert, quartz mica schist, meta-andesite, ore controlled by faulting and shearing.
Production: Yes, small amount.

References: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2439, p. 6127-6129, Stipp et. al., 1967; Arizona Bureau of Mines, Bull 180, 1969; Anderson and Guilbert, 1979.

20. Lucky Star Prospect
Location: 34°15′31"N, 112°23′11"W, Sec. 32, T11N, R1W
Commodity: W
Ore Material: Scheelite
Deposit Description: Vein deposit, grains and stringers, small deposit, 400 feet in length, 3 feet in width, striking N20°E and dipping 82°NW. Scheelite crystals up to one inch in size. Surface and underground workings.
Geology: Mineralization in Precambrian Yavapai schist, mineralization Tertiary in age.
Production: Yes, small amount.
References: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2440, p. 6130-6131.

21. Buster Mine
Location: 34°15′27"N, 112°22′20"W Sec. 33, T11N, R1W
Commodity: Ag
Deposit Description: Small vein deposit, maximum width 4 feet, underground workings. Ore controlled by faulting and shearing.
Geology: Mineralization in Precambrian granodiorite in Cretaceous/Tertiary quartz borite veining.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1982, CRIB Mineral Resources File 12, Record 2441, p. 6132-6134.

22. John Henry Mine
Synonym Name: John Henry 1, 2, 3
Location: 34°19′30"N, 112°08′12"W Sec. 22, T11N, R2E
Commodities: Cu (major), Au, Ag (minor)
Deposit Description: Small massive sulfide lenses, 1200 feet in length, striking N5°E and dipping steeply to the west. Both surface and underground workings.
Geology: Ore controlled by stratigraphy in Precambrian meta-andesite, basalt and chert.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2442, p. 6135-6137.

23. Los Felice Mine
Synonym Name: St. Johns Mine, Townsend
Location: 34°16´26"N, 112°12´44"W
Sec. 1, T10W, R1E
Commodities: Au, Ag, Pb (major); Cu, Fe, Mn, Zn
Ore Materials: Gold, chalcopyrite, galena, hematite
Deposit Description: Small veins averaging 2-3 feet in width, underground workings. Controlled by faulting and shearing.
Geology: Mineralization in Precambrian metaphyolite, chert and quartz mica schist.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2368, p. 5915-5917.

24. Golden Turkey Mine
Location: 34°16´5"N, 112°12´15"W
Sec. 1, T10N, R1E
Commodities: Au, Ag (major); Pb, Cu, Zn (minor)
Ore Materials: Pyrite, galena, sphalerite, chalcopyrite
Deposit Description: Veining in shear zone, small deposit, maximum width 1 foot, striking NE and dipping 20°SE. Underground workings.
Geology: Mineralization in low angle quartz vein which cuts Precambrian metaphyolite, meta-andesite, amphibolite; associated with diorite-basalt dikes of probable Miocene age.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2369, p. 5918-5920.

25. Golden Belt Mine
Location: 34°16´5"N, 112°12´10"W
Sec. 1, T10N, R1E
Commodities: Au (major); Ag, Pb (minor)
Ore Materials: Gold, galena, pyrite
Deposit Description: Vein in shear zone, maximum width 3 feet, striking N60°E and dipping 16°SE, underground workings.
Geology: Deposit is a low angle quartz vein which cuts Precambrian metavolcanics, associated with diorite-basalt dikes of probable Miocene age.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2370, p. 5921-5923; Anderson and Guilbert, 1979.

26. French Lily Mine
Synonym Name: Cedar Talisman
Location: 34°16´12"N, 112°14´W
Sec. 10, 11, T10N, R1E
Commodities: Au (major); Zn, Ag, Cu, Pb (minor)
Deposit Description: Small veins following schist diorite contact, underground workings.
Geology: Mineralization related to quartz vein that cuts Precambrian quartz mica schist and chert. Cretaceous diorite dikes may be related.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2371, p. 5924-5926.

27. Brooks Mine
Synonym Name: American Flag
Location: 34°15´22"N, 112°12´4"W
SE 1/4 sec. 12, T10N, R1E (accuracy within .5 mile)
Commodities: Ag, Au, Pb, Cu, Zn
Ore Materials: Argentiferous galena, ruby silver
Deposit Description: Veins, ore control faulting. Vein zone 1000 feet in length, 200 feet in width with a maximum thickness of 1.5 feet.
Geology: Host rock Precambrian metarhyolite, chert, amphibolite, Miocene andesite associated with deposit.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2372, p. 5927-5929.

28. Silver Cord Mine
Synonym Name: Silver Cord, Gold Crown, Infant
Location: 34°15´17"N, 112°12´19"W
SW 1/4 SE 1/4 sec. 12, T10N, R1E
Commodities: Ag, Au, Pb (major); Cu, Zn (minor)
Ore Materials: Prousite, silver, silver chloride, argentiferous galena, sphalerite, pyrite, gold.
Deposit Description: Vein deposit controlled by faulting and shearing, small flat lying vein, 5 feet thick at maximum width. Underground workings.
Geology: Host rock Precambrian chert, metarhyolite, and amphibolite. Associated with Miocene andesite dikes.
Production: Yes.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2373, p. 5930-5932.

29. Cutter Mine
Synonym Name: Cutter Claim
Location: 34°15´2"N, 112°12´41"W
NE 1/4 sec. 13, T10N, R1E
Commodities: Ag, Pb (major); Au, Cu (minor)
Ore Materials: Silver, argentiferous galena.
Deposit Description: Vein deposit, small vein with a maximum thickness of 5 feet, with very shallow dip. Underground workings.
Geology: Host rock is Precambrian chert, metarhyolite, amphibolite, associated with andesite dikes.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2374, p. 5933-5935.

30. Bi-Metals Mine
Synonym Name: Snaffle Mine, Sneffell Mine, Santa Rosa Mine
Location: 34°14´54"N, 112°13´43"W
SE 1/4 NW 1/4, sec. 14, T10N, R1E
Commodities: Au, Ag, Zn, Pb (major); Cu (minor)
Ore Materials: Gold, argentiferous galena, chalcopyrite, sphalerite.
Deposit Description: Quartz veining controlled by faulting and shearing, maximum thickness 6 feet.
Geology: Deposit is a brecciated quartz vein which trends parallel to a dike of quartz monzonite. Dike intrudes Precambrian amphibolite and quartz mica schist.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2375, p. 5936-5938.

31. Bill Arp Mine
Location: 34°13´32"N, 112°13´14"W
SW 1/4 SE 1/4, sec. 22, T10N, R1E
Commodities: Ag, Pb, Cu (major); Au (minor)
Ore Materials: Ruby silver, galena
Deposit Description: Quartz veins, deposit size 385 feet in length, 215 feet in width, with a maximum thickness of 5 feet. Underground workings.
Geology: Veining cuts across schistosity of Precambrian quartz mica schist and is associated with quartz monzonite.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2376, p. 5939-5941.

32. Howard Silver Mine
Location: 34°13´40"N, 112°12´40"W
NE 1/4 SW 1/4, sec. 24, T10N, R1E
Commodities: Ag, Cu, Zn
Ore Materials: Galena, sphalerite
Deposit Description: Quartz veining controlled by faulting and shearing, small tabular deposit 400 feet in length, 250 feet wide and 4 feet thick maximum. Underground workings.
Geology: Veining in Precambrian amphibolite.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2377, p. 5942-5944.

33. R and H Mine
Location: 34°13´30"N, 112°12´52"W
SW 1/4 SW 1/4 sec. 24, T10N, R1E
Commodities: Ag, Pb (major); Cu (minor)
Ore Materials: Small, tabular vein. Underground workings.
Geology: Veining in Precambrian metavolcanic rocks.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2378, p. 5945-5947.

34. Thunderbolt Mine
Location: 34°14´7"N, 112°12´21"W
N 1/2, sec. 24, T10N, R1E
Commodities: Ag (major); Pb, Zn, Au, Cu (minor)
Ore Materials: Proustite, galena, sphalerite, silver
Deposit Description: Tabular vein in fissure zone. Maximum length 1 mile, width 325 feet, underground workings.
Geology: Veining and mineralization controlled by faulting and shearing, quartz veining cuts Precambrian metarhyolite, andesite, amphibolite, and may be spatially related to diorite basalt dikes that are of probable Miocene age.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1974, 1981, CRIB Mineral Resources File 12, Record 2379, p. 5948-5950.

35. H. S. Tungsten Prospect
Location: 34°12´54"N, 112°12´26"W
Sec. 25, T10W, R1E
Commodities: W (major); Ag, Pb, Zn (minor)
Ore Material: Scheelite

Deposit Description: Veins, stringers, small deposit, maximum width 4 feet, concentrated along N75°W fracture system, underground workings.
Geology: Precambrian granite, pegmatite, aplite, schist. Schistosity parallels strike of vein.
Production: Yes, small amount.
Reference: USGS, 1979, CRIB Mineral Resources File 12, Record 2380, p. 5951-5952.

36. Minnehaha Placers
Location: 34°11′27"N, 112°23′60"W
T10W, R1W, T10N, R2W (general location for localities)
Commodity: Au
Ore Material: Gold
Deposit Description: Placer deposit with surface workings.
Geology: Placers in Quanternary gravels, associated with Precambrian lode gold veins.
Production: Yes, small amount.
Reference: USGS, 1979, CRIB Mineral Resources File 12, Record 2381, p. 5953-5955.

37. Bluebird Mine
Synonym Name: Bluebird
Location: 34°14′28"N, 112°19′7"W
NW 1/4 Sec. 1, T10N, R1W
Commodities: Au, Ag, Pb (major); Cu (minor); Zn (potential); Mo (occurrence).
Deposit Description: Vein, tabular, ore control related to faulting. Ore body strikes N30°E and dips 70°W. Underground workings.
Geology: Host rock Precambrian schist, quartzite, iron formation, associated with Cretaceous/Tertiary igneous rocks.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2382, p. 5956-5958.

38. Lincoln Mine
Location: 34°13′57"N, 112°19′22"W
SW 1/4 SW 1/4 sec. 1, T10N, R1W
Commodities: Au (major); Ag, Pb, Cu (minor); Zn (potential)
Ore Materials: Pyrite, chalcopyrite, sphalerite, galena, tetrahedrite.
Deposit Description: Vein, tabular, 400 feet in length, 6 feet wide, strikes N18°E and dips W. Underground workings.

Geology: Deposit is vein that cuts Precambrian quartzite and schist. Igneous rocks of Cretaceous/Tertiary age are near deposit.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2383, p. 5959-5961.

39. Gladiator Mine
Location: 34°13'60"N, 112°19'58"N
SW 1/4 sec. 2, T10N, R1W
Commodities: Ag, Au, Zn, Pb (major); Cu (minor)
Ore Materials: Galena, tetrahedrite, native gold, sphalerite, chalcopyrite.
Deposit Description: Lode (vein), tabular, underground workings.
Geology: Cretaceous/Tertiary veins cut Precambrian metavolcanic rocks.
Production: Yes, small amount.
References: USGS, 1981, CRIB Mineral Resources File 12, Record 2384, p. 5962-5964; Anderson and Guilbert, 1979.

40. Fairview Mine
Synonym Name: Hill Billy
Location: 34°14'19"N, 112°20'10"W
Sec. 2, T10N, R1W
Commodities: Au, Ag
Ore Materials: Pyrite, chalcopyrite
Deposit Description: Vein, shear zone, lenticular deposit, maximum width 4 feet. Underground workings.
Geology: Mineralization is in a vein that cuts Precambrian quartzite and schist. Igneous rocks of Cretaceous/Tertiary age are close to the deposit.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2385, p. 5965-5967.

41. Del Pasco Mine
Location: 34°13'52"N, 112°20'43"W
SE 1/4 sec. 3, T10N, R1W
Commodities: Au (major); Ag, Pb, Zn, Cu (minor)
Ore Materials: Sphalerite, pyrite, galena.
Deposit Description: Vein, tabular, small, 3 feet in width, strikes N-NE and dips 70°NW. Underground workings.
Geology: Mineralization in vein that cuts Precambrian quartzite and schist. Igneous rocks of Cretaceous/Tertiary age are close to deposit.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2386, p. 5968-5970.

42. Saratoga Mine
Synonym Name: Saratoga claim
Location: 34°13´15"N, 112°20´47"W
NE 1/4 sec. 10, T10N, R1W
Commodities: Au, Ag, Pb, Cu (major); Zn (potential)
Ore Materials: Sphalerite, auriferous pyrite, chalcopyrite, gold, galena.
Deposit Description: Vein, tabular, faulting, shearing control, small ore body striking N20°E and dipping 70°W.
Geology: Mineralization in Precambrian metavolcanic rocks and Cretaceous/Tertiary granodiorite.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2387, p. 5971-5973.

43. Crown King Mine
Location: 34°13´28"N, 112°20´34"W
E 1/2 sec. 10, T10N, R1W
Commodities: Au, Ag, Zn, Cu, Fe, Pb
Ore Materials: Sphalerite, pyrite, chalcopyrite, native gold
Deposit Description: Vein, tabular, faulting, shearing. Small ore body 2 feet in width, underground workings.
Geology: Vein cuts Precambrian quartzite and schist, igneous rocks of Cretaceous/Tertiary age are close to deposit.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2388, p. 5974-5976; Arizona Bureau of Mines Bull. 180, 1969.

44. Wildflower Mine
Location: 34°13´45"N, 112°21´18"W
NW 1/4 sec. 10, T10N, R1W
Commodities: Ag, Au (major); Cu, Zn, Pb (minor)
Ore Materials: Sphalerite, chalcopyrite, pyrite
Deposit Description: Vein, shear zone, veining parallels regional foliation. Underground workings.
Geology: Mineralization in Precambrian metagabbro
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2389, p. 5977-5979.

45. Philadelphia Mine
Location: 34°12´58"N, 112°20´19"W
Sec. 11,14, T10N, R1W
Commodities: Au, Ag
Deposit Description: Vein, maximum width 5 feet, small underground workings.
Geology: Cretaceous-Tertiary granodiorite which intrudes Precambrian metamorphic and plutonic rocks.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1982, CRIB Mineral Resources File 12, Record 2390, p. 5980-5982.

46. Union Mine
Synonym Name: Union Group, Union and Eagle Claim
Location: 34°12´54"N, 112°20´52"W
N 1/2 sec. 15, T10N, R1W
Commodities: Ag, Cu, Au (major); Pb (minor), Zn (potential)
Ore Materials: Argentiferous galena, chalcopyrite, gold, galena, sphalerite.
Deposit Description: Vein, tabular, small deposit with underground workings.
Geology: Mineralization localized along rhyolite dikes that cut Cretaceous-Tertiary granodiorite which cuts Precambrian metamorphic and plutonic rocks.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2391, p. 5983-5985.

47. Springfield Mine
Location: 34°12´28"N, 112°22´18"W
SW 1/4 sec. 16, T10N, R1W
Commodities: Cu (major); Pb, Ag, Au (minor)
Ore Materials: Chalcopyrite, pyrite, chalcocite
Deposit Description: Porphyry, breccia pipe, chimney shaped. 30 feet in width, underground workings.
Geology: Cretaceous-Tertiary granodiorite which intrudes Precambrian metamorphic and plutonic rocks.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2392, p. 5986-5988; Stipp et. al., 1967; Arizona Bureau of Mines Bull. 180, 1969.

48. Harrington Mine
Synonym Name: Harrington Group
Location: 34°11´48"N, 112°21´W
NE 1/4 sec. 22, T10N, R1W
Commodities: Au, Ag (major); Cu (minor)
Deposit Description: Vein, tabular, small underground workings.
Geology: Veins cut Cretaceous-Tertiary granodiorite, rhyolite porphyry dikes nearby.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2393, p. 5989-5991.

49. Old Tiger Mine
Synonym Name: California Gen. No. 70
Location: SE 1/4 sec. 22, T10N, R1W
Commodities: Ag, Cu, Pb (major); Au (minor); Zn (potential)
Ore Materials: Galena, sphalerite, tetrahedrite, pyrite, chalcopyrite.
Deposit Description: Vein, tabular, small body striking N25°E and dip 60°W.
Geology: Vein cut Cretaceous-Tertiary granodiorite.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2394, p. 5992-5994.

50. M and M Prospect
Location: 34°11´24", 112°21´07"W
Sec. 22, T10N, R1W
Commodities: Ag, Cu (major); Zn, Pb, Au (potential)
Ore Materials: Argentiferous galena, sphalerite, tetrahedrite, ankerite, pyrite
Deposit Description: Small vein, 6 inches wide, maximum width 3 feet. Ore body strikes N18°E dipping W.
Geology: Vein cuts Cretaceous-Tertiary granodiorite which cuts Precambrian metamorphic and plutonic rocks.
Production: Yes.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2395, p. 5995-5997.

51. Savoy Mine
Location: 34°10´44"N, 112°20´19"W
SW 1/4 sec. 26, T10N, R1W
Commodities: Ag, Pb, Cu, Au (major); Zn (potential)
Ore Materials: Argentiferous galena, sphalerite, cerargyrite, argentite, silver
Deposit Description: Vein, tabular, almond shaped pod with long axis near vertical.
Geology: Cretaceous-Tertiary vein deposit cuts Precambrian quartz-mica schist.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2396, p. 5998-6000.

52. Cougar Mine
Location: 34°11´3"N, 112°20´6"W
Sec. 26, T10N, R1W
Commodities: Ag, Au, Pb, Zn
Ore Materials: Ankerite, sphalerite, galena, pyrite, cerargynite, argentite, native silver
Deposit Description: Small vein deposit with underground workings.
Geology: Vein cuts Precambrian quartzite and schist, igneous rocks of Cretaceous-Tertiary age are close to deposit.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2397, p. 6001-6003.

53. Arizona Mascott Mine
Synonym Name: Mascott Mine
Location: 34°10´29"N, 112°20´43"W
SE 1/4 SE 1/4 sec. 27, T10N, R1W
Commodities: Au (major); Ag, Cu (minor)
Ore Materials: Gold, unknown
Deposit Description: Small vein deposit with underground workings.
Geology: Vein cuts Precambrian quartz-mica and calc-silicate schists. Rhyolite porphyry dikes are sometimes associated with the veins.

Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2398, p. 6004-6006.

54. Pilgrim Mine
Synonym Name: Pilgrim Claim
Location: 34°10´34"N, 112°20´30"W
SE 1/4 sec. 27, T10N, R1W
Commodities: Au, Ag, Cu (major); Zn (potential)
Ore Materials: Auriferous pyrite, chalcopyrite
Deposit Description: Vein, tabular, 500 feet in length, 100 feet in width, 3 feet in thickness. Ore body strikes N10°W, to N20°E and dips 55° to 67°W.
Geology: Precambrian schist forms hanging wall of vein quartz monzonite forms footwall of vein.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2399, p. 6007-6009.

55. Tiger Mine
Location: NW 1/4, Sec. 27, T10N, R1W
Commodities: Ag, Cu, Au (major); Pb (minor); Zn (potential)
Ore Materials: Pyrite, sphalerite, galena, tetrahedrite, chalcopyrite
Deposit Description: Vein, small ore deposit 20 feet in width, striking N20°E and dipping 65°W. Underground workings.
Geology: Vein cuts Cretaceous-Tertiary granodiorite, rhyolite dikes nearby.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1974, 1981, CRIB Mineral Resources File 12, Record 2400, p. 6010-6012.

57. Oro Belle Mine
Synonym Name: Oro Belle - Gray Eagle
Location: 34°10´14"N, 112°20´42"W
NE 1/4 NE 1/4, sec. 34, T10N, R1W
Commodities: Au (major); Ag, Cu (minor)
Deposit Description: Vein, maximum width 15 feet, striking NNE.
Geology: Vein which cuts Precambrian quartzite and schist. Igneous rocks of Cretaceous-Tertiary age are close to the deposit.
Production: Yes, 1 oz. Au/T, 2 oz. Ag/T, 1% Cu.
Reference: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2402, p. 6015-6017.

61. Richinbar Mine
Location: 34°12´7"N, 112°6´5"W
Sec. 36, T10N, R2E

Commodities: Au (major); Ag, Pb, Cu (minor)
Ore Materials: Free gold, pyrite, chalcopyrite, galena, sphalerite
Deposit Description: Veins, lenticular, pinch and swell, verticle shoots. Small body 500 feet in length, 500 feet in width, 30 feet thick. The ore body dips 80°W. Underground workings.
Geology: Quartz pyrite vein in Precambrian quartz diorite.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1982, CRIB Mineral Resources File 12, Record 2406, p. 6026-6029; Stipp et. al., 1967.

63. Black Canyon Placers
Location: 34°11´35"N, 112°10´20"W
T9 1/2N R2E, T10N R2E
(location is general for placer area)
Commodity: Au
Ore Material: Gold
Deposit Description: Placer.
Geology: Deposit in quaternary gravels, from Precambrian-Tertiary gold-quartz veins.
Production: Yes, small amount.
References: USGS, 1979, CRIB Mineral Resources File 12, Record 2347, p. 5852-5853; USGS Bull. 1355, 1972.

64. Blade Prospect
Location: 34°9´N, 112°14´51"W
Sec. 3, T9N, R1E
Commodity: W
Ore Materials: Wolframite, scheelite
Deposit Description: Shear zone, vein 6 feet in width. Surface and underground workings.
Geology: Deposit is quartz vein which cuts Precambrian quartz monzonite. Deposit possibly related to rhyolite porphyry dikes nearby.
Production: Yes, small amount.
Reference: USGS, 1973, updated 1979, CRIB Mineral Resources File 12, Record 2348, p. 5854-5856.

66. Lane Mine
Location: 34°8´16"N, 112°19´25"W
Sec. 11,12, T9N, R1W (location is approximate)
Commodities: Au, Ag (major); Pb, Zn (potential)
Ore Materials: Galena, sphalerite
Deposit Description: Vein, disseminated porphyry lens, massive small body, 4 feet thick, striking N50°E dipping 75° NW. Underground workings.

Geology: Precambrian quartz monzonite Tertiary rhyolite dikes, small porphyry-related deposits spatially associated with rhyolite dike swarms.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1982, CRIB Mineral Resources File 12, Record 2350, p. 5860-5862; Stipp et. al., 1967.

68. Blanchiana Prospect
Location: 34°9´3"N, 112°9´11"W
Sec. 4, T9N, R2E
Commodity: Au
Ore Materials: Free gold, sulfides
Deposit Description: Vein, small, 2 feet in width.
Geology: Deposits in quartz-pyrite vein in Precambrian quartz diorite.
Production: Yes, small amount.
Reference: USGS, 1972, updated 1979, 1982, CRIB Mineral Resources File 12, Record 2352, p. 5865-5867.

71. Maggie Mine
Synonym Name: Maggie and Bella, Little Maggie
Location: NW1/4 NW1/4 sec. 22, T9N,R2E
Commodities: Au, Ag
Ore Material: Gold
Deposit Description: Vein, tabular, small body 100 feet in length and 120 feet in width. Underground workings.
Geology: Quartz vein cuts Precambrian granodiorite.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2355, p. 5874-5876.

72. Gloryana Mine
Synonym Name: Gloriana, Valencia Mine, Valencienne
Location: 34°9´14"N, 112°9´27"W
NE1/4 sec. 4, T9N, R2E
Commodities: Au, Ag (major); Cu (minor)
Deposit Description: Vein, tabular, small underground workings.
Geology: Quartz-pyrite vein in Precambrian quartz diorite.
Production: Yes, small amount.
References: USGS, 1981, CRIB Mineral Resources File 12, Record 2356, p. 5877-5879; Stipp et. al., 1967.

74. C and W Prospect
Location: W1/2 sec 25, T9N, R2W
Commodity: W
Ore Materials: Wolframite, scheelite
Deposit Description: Shear zone, veins, lenticular, small, 2 inches maximum width, dipping 80°SE. Underground workings.
Geology: In Precambrian Yavapai schist, Precambrian granite and pegmatite sills nearby.

Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1982, CRIB Mineral Resources File 12, Record 2358, p. 5883-5885, Stipp et. al., 1967.

75. Golden Aster Mine
Synonym Name: Lehman Mine, Lehman Property, Rattle Snake Vein
Location: 34°5´41"N, 112°27´18"W
NW1/4 SW1/4 NE1/4 sec. 27, T9N, R2W
Commodities: Au (major); Ag, Cu (minor)
Ore Materials: Unknown sulfides, gold
Deposit Description: Vein, tabular, 3 parallel veins close together, 2 feet, 6 inches, and 6 feet wide. Ore body strikes N10°W, dips 25°W.
Geology: Deposit is a quartz vein localized along low angle fault which probably displaces Tertiary volcanic rocks. Host rocks Tertiary phyolite, Precambrian quartz-mica schist, amphibole schist, granite.
Production: Yes, small amount.
References: USGS, 1981, CRIB Mineral Resources File 12, Record 2359, p. 5886-5888, Stipp et. al., 1967.

76. Bunker Hill Mine
Synonym Name: Duco Boy, Old Bradshaw Workings
Location: 34°4´59"N, 112°29´31"W
SW1/4 NE1/4 NW1/4, sec. 32, T9N, R2W
Commodities: Au (major); Ag, Cu (minor); Pb (potential); V, Mo (occurrence).
Ore Materials: Silver, galena, sphalerite, gold
Deposit Description: Vein, tabular, maximum thickness 5 1/2 feet, ore body strikes N60°-N70°W, underground workings.
Geology: Quartz vein localized along low angle fault which probably displaces Tertiary volcanic rocks to the southeast. Host rocks are Precambrian quartz-mica schist, amphibole schist, granite, and Tertiary rhyolite.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2360, p. 5889-5891.

77. Champie Mine
Synonym Name: Lone Star, Lehman
Location: NE1/4 of SW1/4 sec 33, T9N, R2W
Commodities: Ag, Cu, Pb (major), Au (minor)
Ore Materials: Chrysocolla, specularite, limonite (auriferous)
Deposit Description: Vein, tabular, 5 feet thick, strikes N30°W to N20°W and dips 35° to 45°SW. Veins parallel low angle faults which trend NW. Underground workings.
Geology: Quartz vein along low angle fault in Tertiary granite and rhyolite.

Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2361, p. 5892-5894.

78. Copperopolis Mine
Location: 34°4´46"N, 112°27´47"W
SW1/4 NE1/4 sec. 34, T9N, R2W
Commodities: Cu (major); Pb, Ag (minor)
Ore Materials: Limonite, chrysocolla, galena
Deposit Description: Veins, small, 2 veins, striking N60°W and N70°W and surface and underground workings.
Geology: Veins parallel low angle faults which trend NW, mineralization in Precambrian schists and granite, Tertiary rhyolite. Two ages of mineralization may be present. Older E trending lead veins and younger E trending copper.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2362, p. 5895-5897; Stipp et. al., 1967.

79. Maybe Mine
Synonym Name: Foy Group, Foy, Belcher, Maybe Prospect
Location: 34°3´38"N, 112°16´26"W
NW1/4 of NW1/4 sec. 4, SW1/4SW1/4 sec. 5, T8N, R1E
Note: Location estimate is middle of group of shafts in Section 4.
Commodities: Ag (major); W (minor)
Ore Materials: Silver, wolframite, scheelite
Deposit Description: Vein, tabular, pinch and swell, deposit 50 feet in length, 4 feet thick, strikes N30°E, and dips 80°NW. Surface workings.
Geology: Vein system cuts Precambrian quartz monzonite, rhyolite porphyry dikes of Tertiary age are nearby.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2307, p. 5730-5732.

80. Humbug Mines
Synonym Name: Acquisition, Mountain Chief, Occident, Fogarty, Queen, Little Annie, Heinie, Lind, and Columbia
Location: 34°2´48"N, 112°18´22"W
Sec. 6,7,18 T8N, R1E,
Sec. 1,12,13 T8N, R1W
(Location is a group location)
Commodities: Au, Ag, Pb, Zn, As; Sb (occurrence)
Ore Materials: Pyrite, galena, sphalerite, arsenopyrite, free gold
Deposit Description: Vein, shear zone, small body, 9000 feet in length, 3 feet in width. Ore body strikes to NE and dips to the NW.

Geology: Mineralization in Precambrian Yavapai schist, pegmatite and granite. Tertiary rhyolite to granite porphyry dikes.
Production: Yes, small amount in 1913.
References: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2308, p. 5733-5735; Arizona Bureau of Mines, Bull. 180, 1969.

81. Little Joseph Mine
Synonym Name: Little Joe, Acquisition (?), Columbia Gold Mining Property
Location: 34°3'5"N, 112°17'58"W
SE1/4 of NW1/4, sec. 7, T8N, R1E
Commodities: Au, Ag, Cu (major); Pb (minor)
Ore Materials: Gold, auriferous pyrite, and arsenopyrite, chalcopyrite, galena
Deposit Description: Vein, tabular, faulting, shearing, small deposit, 700 feet in length, 400 feet in width, 3 feet thick. Deposit strikes W48°E, and dips 70°-80°NW.
Geology: Host rocks Precambrian quartz monzonite, Tertiary rhyolite porphyry. Veins parallel rhyolite porphyry dikes and foliation in Precambrian xenoliths.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2309, p. 5736-5738.

82. Golden Central Mine
Synonym Name: Gold Central
Location: SW1/4 of NW1/4, sec. 7, T8N, R1E
Commodities: Cu, Pb, Au, Ag
Ore Materials: Chalcopyrite, galena, gold, argentiferous galena, unknown copper minerals
Deposit Description: Vein, tabular, small deposit, 2000 feet in length, 50 feet in width, 2 feet thick, and strikes N65°E and dips 75°-80°NW. Underground workings.
Geology: Vein in Precambrian quartz monzonite, Tertiary rhyolite porphyry. Veins parallel phyolite porphyry dikes and foliation in Precambrian xenoliths.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2310, p. 5739-5741.

83. Museum Mine
Synonym Name: Museum Group, Silver Museum
Location: 34°3'25"N, 112°16'43"W
NE1/4 sec. 8, T8N, R1E
Commodities: Ag (major); Au, Cu (minor); W (potential)
Ore Materials: Silver, unknown
Deposit Description: Vein, tabular, small with surface and underground workings.

Geology: Vein system cuts Precambrian quartz monzonite, Tertiary rhyolite porphyry dikes occur in area, but are not necessarily coincident with veins.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2311, p. 5742-5744.

84. Tom Wade Mine
Synonym Name: 4th of July Group
Location: 34°3´7"N, 112°15´39"W
NE1/4 sec. 9, T8N, R1E
Commodities: Au, Ag (major); Cu, Pb (minor); W (potential)
Ore Materials: Gold, silver, argentiferous galena, unknowns, wolframite
Deposit Description: Vein, tabular, small deposit, strikes N65°E, dips 70° to 80°NW
Geology: Vein system cuts Precambrian quartz monzonite Tertiary rhyolite porphyry dikes occur in district but are not necessariy coincident with veins.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2312, p. 5745-5747.

85. Seventy-Six Mine
Synonym Name: 76, Seventy-Six Claim
Location: 34°3´12"N, 112°15´19"W
SE1/4 NE1/4 sec. 9, T8N, R1E
Commodities: Ag, Pb (major); Cu, Au (minor); Zn (potential); W (occurrence)
Ore Materials: Silver, ruby silver, stibnite, gold, galena, chalcopyrite, sphalerite, cerargyrite, prousite
Deposit Description: Vein, tabular, deposit 1000 feet in length, 180 feet in width, 6 feet thick. The ore body strikes N55°-65°E, and dips 70°NE. Underground workings.
Geology: Deposit is quartz vein which parallel to Tertiary rhyolite dikes, both of which cut Precambrian quartz monzonite.
Production: 300 tons from 1936-1940.
References: USGS, 1981, CRIB Mineral Resources File 12, Record 2313, p. 5748-5750; Stipp et. al., 1967.

86. Tip Top Mine
Synonym Name: Conqueror
Location: 34°3´9"N, 112°15´11"W
Sec. 10, T8N, R1E
Commodities: Ag, Au, Pb, Cu, Zn, W, As, Be
Ore Materials: Wolframite, galena, tetrahedrite, arsenopyrite, pyrite, sphalerite, bornite, cerargyrite, ruby silver, gold.

Deposit Description: Vein, Tabular, pinch and swell, 1200 feet in length, 750 feet in width, and 6 feet wide. Ore body strikes N55°E and dips 67°NW. Oxidation goes 200 feet below surface.
Geology: Vein system cuts Precambrian quartz monzonite. Tertiary rhyolite dikes occur in area but are not necessarily coincident with veining.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2314, p. 5751-5754; Stipp et. al., 1967; Arizona Bureau of Mines Bull. 180, 1969.

87. Golden Anchor Mine
Location: 34°1′40"N, 112°17′12"W
NW1/4 sec. 20, T8N, R1E
Commodities: Au, Ag, Pb (major); Cu (minor); Zn (potential)
Deposit Description: Vein, tabular, underground workings.
Geology: Mineralization in Precambrian quartz monzonite and Tertiary rhyolite porphyry.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2315, p. 5755-5757.

88. Great Cross Cut Prospect
Synonym Name: Pearl Adit, "Glory Hole", Johnson Group
Location: 34°1′N, 112°17′4"W
SW1/4 sec. 20, NW1/4 sec. 29, T8N, R1E
Commodities: W, Ag, Au
Ore Materials: Silver, gold, wolframite, scheelite
Deposit Description: Vein, tabular, pinch and swell. Deposit 3000 feet in length, 100 feet in width, and 3 feet thick. The ore body strikes N10°-25°E and dips 55°-80°W. Surface and underground workings.
Geology: Vein system cuts Precambrian quartz monzonite and schist. Tertiary rhyolite pophyry dikes occur in faults and are coincident with veins.
Production: Yes, small amount.
Reference: USGS, 1972, CRIB Mineral Resources File 12, Record 2316, p. 5758-5761.

89. Lapan Mine
Synonym Name: Liana Mine, Humbug Mine, Humbug Gold Property, Lind-Fogarty Claims
Location: 34°3′43"N, 112°18′41"W
NW1/4 SE1/4 sec. 1, T8N, R1W
Commodities: Au, Ag, Pb (major); Cu (minor)
Ore Materials: Gold, auriferous pyrite and arsenopyrite, argentiferous galena, chalcopyrite
Deposit Description: Vein, tabular, small deposit 5 feet thick that strikes N60°E and dips steeply to the north.
Geology: Mineralization in Precambrian quartz monzonite and Tertiary rhyolite porphyry.

Production: Yes, small amount.
References: USGS, 1981, CRIB Mineral Resources File 12, Record 2317, p. 5762-5764, Stipp et. al., 1967.

90. El Dorado Mine
Synonym Name: Security, 4th of July Group
Location: 34°3´2"N, 112°15´53"W
SW1/4 sec. 9, T8N, R1W
Commodities: Ag (major); Pb (potential)
Ore Materials: Galena, unknowns
Deposit Description: Vein, tabular, small deposit, 700 feet in length, strikes N65°-70°E and dips steeply to the NW. Underground workings.
Geology: Vein system cuts Precambrian quartz monzonite. Tertiary rhyolite porphyry dikes occur nearby, but are not necessarily coincident with veins.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2318, p. 5765-5767.

91. El Pero Bonite Mine
Synonym Name: Mountain Chief Mine, Pero Bonito Mine
Location: 34°3´15"N, 112°18´28"W
NE1/4 NE1/4 sec. 12, T8N, R1W
Commodities: Cu, Ag, Au
Ore Materials: Chalcopyrite, gold, argentiferous galena, unknown copper minerals
Deposit Description: Vein, tabular lens, small deposit, 1800 feet in length, 500 feet in width, and 3 feet thick. Ore body strikes N50°E.
Geology: Vein is in Precambrian quartz monzonite adjacent to rhyolite porphyry dike.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2319, p. 5768-5770.

92. Golconda Mine
Synonym Name: Golconda Claim
Location: 34°3´23"N, 112°18´27"W
NE1/4 NE1/4 sec. 12, T8N, R1W
Commodities: Au, Ag
Ore Materials: Gold, auriferous pyrite and arsenopyrite
Deposit Description: Vein, tabular, small deposit, 1500 feet in length, 50 feet in width and 2 feet thick. Ore body strikes N60°E and dips 75°-80°NW.
Geology: Mineralization in Precambrian quartz monzonite and Tertiary rhyolite porphyry. Veins parallel rhyolite porphyry dikes and foliation in Precambrian xenoliths.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2320, p. 5771-5773.

93. Columbia
Synonym Name: Humbug Creek, Humbug District
Location: 34°2´2"N, 112°18´39"W
Sec. 13, T8N, R1W
Commodities: Au (major); Pt (minor)
Ore Materials: Magnetite, hematite, gold
Deposit Description: Placer
Geology: Unknown
Production: Yes, small amount.
Reference: USGS, 1975, updated 1979, 1982, CRIB Mineral Resources File 12, Record 2321, p. 5774-5776.

94. Black Buck Prospect
Location: 34°0´7"N, 112°21´28"W
Sec. 27, 34, T8N, R1W
Commodity: Mn
Ore Materials: Manganese oxides
Deposit Description: Veins, shear zone, lenticular, small deposit, 600 feet in length, 6 feet in width, and strikes NW. Underground workings.
Geology: Host rock Precambrian granite
Production: Yes, small amount.
References: USGS, 1979, CRIB Mineral Resources File 12, Record 2322, p. 5777-5778; Stipp et. al., 1967; Arizona Bureau of Mines Bull. 180, 1969.

95. Kay Copper Mine
Location: 34°3´37"N, 112°9´35"W
SE1/4 SW1/4 sec. 4, NW of NE and NW1/4 sec. 9, T8N, R2E
Commodities: Cu, Pb, Ag (major); Au (minor); Zn (potential)
Ore Materials: Chalcopyrite, galena, auriferous pyrite, sphalerite, tetrahedrite
Deposit Description: Stratiform massive sulfide, lense shaped, 2 ore bodies, reserve estimates vary from 180,000 tons to 1,400,000 tons. Underground workings.
Geology: Host rocks Precambrian metarhyolite, meta-andesite, quartz-mica schist.
Production: Yes, small amount.
References: USGS, 1981, CRIB Mineral Resources File 12, Record 2323, p. 5779-5782; Anderson and Guilbert, 1979.

97. Whipshaw Mine
Location: 34°2´49"N, 112°28´49"W
Sec. 3, T8N, R2W
Commodities: Au, Cu (major); Ag (minor)
Ore Materials: Chrysocolla, gold, specularite
Deposit Description: Small vein deposit, 4 feet in width, and strikes NW, dips to SW. Underground workings.
Geology: Deposit is quartz vein localized along low angle fault in Tertiary rhydite and Precambrian quartz mica schist and amphibole schist.

Production: Yes, small amount.
References: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2325, p. 5785-5787; Stipp et. al., 1967.

98. Robey Mine
Synonym Name: Roby, Roby and Sons, Robey and Sons
Location: 34°2´11"N, 112°28´9"W
Center sec. 16, T8N, R2W
Commodities: Au (major); Ag, Pb, Cu (minor)
Deposit Description: Vein, tabular, 1.5 feet thick. Underground workings.
Geology: Quartz vein localized along a low fault in Tertiary rhyolite and Precambrian quartz-mica schist and amphibole schist.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2326, p. 5788-5790.

100. Black Dome Prospect
Location: 34°20"N, 112°26´25"W
Sec. 26, T8N, R2W
Commodity: Mn
Ore Materials: Pyrolusite, psilomelane
Deposit Description: Shear zone, small deposit, 1200 feet in length, 200 feet in width, and strikes E-W. Surface workings.
Geology: Mineralization in Tertiary volcanics.
Production: Yes, small amount.
Reference: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2328, p. 5794-5795.

101. Willis Mine
Synonym Name: Buckhorn Property
Location: 34°37"N, 112°27´59"W
SW1/4 NE1/4 sec. 28, T8N, R2W
Commodities: Cu, Au (major); Ag (minor)
Deposit Description: Vein, tabular, small deposit with underground workings.
Geology: Quartz vein along low angle fault in Tertiary rhyolite, Precambrian quartz-mica schist, amphibole schist.
Production: Yes, small amount.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2329, p. 5796-5798.

102. Midnight Owl Mine
Synonym Name: Lithia King
Location: 33°59´54"N, 112°30´48"W
NW1/4 NW1/4 sec. 31, T8N, R2W
Commodities: Feldspar (major); Be, Li, Nb, Ta
Ore Materials: Lepidolite, amblygonite, lithiophilite, triphilite, columbite-tantalite, beryl.
Deposit Description: Pegmatite, irregular, tabular. Small deposit, 350 feet in length, 100 feet in width, striking E. Surface workings.

Geology: Precambrian pegmatite dike, in Precambrian gneiss and schist.
Production: Yes.
References: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2330, p. 5799-5801; Arizona Bureau of Mines Bull. 180, 1969.

103. Swallow Mine
Synonym Name: Dobler, Moonlight
Location: 34°35´26"N, 112°30´30"W
S1/2 sec. 6, NE1/4 NW1/4 sec. 7, T8W, R2W
Commodities: Cu, Au (major); Ag (minor)
Ore Materials: Chrysocolla, copper carbonates, chalcocite, auriferous pyrite, fluorite
Deposit Description: Vein, tabular, small deposit, 2 main veins go NW to SE, several other veins oriented N-S. Surface and underground workings.
Geology: Quartz vein localized along low-angle fault in Tertiary rhyolite and Precambrian quartz-mica schist amphibole schist and granite.
Production: Yes, small amount.
References: USGS, 1981, CRIB Mineral Resources File 12, Record 2331, p. 5802-5804; Arizona Bureau of Mines Bull. 180, 1969.

104. Cummings Mine
Synonym Name: Manganese 1-12
Location: 33°56´53"N, 112°19´28"W
Sec. 13,14, T7N, R1W
Commodity: Mn
Ore Material: Psilomelane
Deposit Description: Placer, blanket shaped, small deposit, 1000 feet in length, 300 feet in width and 4 feet thick. Surface workings.
Geology: Deposit in quanternary soil and detrital material, manganese bearing soil rests on hard cemented gravel.
Production: Yes, small amount.
References: USGS, 1972, updated 1979, 1981, CRIB Mineral Resources File 12, Record 2299, p. 5706-5708; Stipp et. al., 1967.

105. Golden Slipper Mine
Location: 33°57´18"N, 112°30´29"W
SW1/4 SE1/4 sec. 18, T7N, R2W
(estimated location)
Commodities: Au (major); Cu, Ag (minor)
Deposit Description: Vein, shear zone, small deposit, 25 feet wide and 3 feet thick, underground workings.
Geology: Deposit in quartz vein which cuts Tertiary rhyolite, dacite, tuff.
Production: Yes, small amount.
Reference: USGS, 1979, updated 1981, CRIB Mineral Resources File 12, Record 2300, p. 5709-5711.

177. Burmeister
Location: Sec. 20, T11W, R3E
Commodity: Mn
Deposit Description: Hot Spring.
Production: Yes, small amount.
References: Stipp, Haigler, Alto and Sutherland, 1967; Arizona Bureau of Mines Bull. 180, 1969

188. Cleator
Location: Sec. 12, T10N, R1W, location very approximate
Commodity: Fe
Deposit Description: Taconite like iron formation.
Production: Less than 100 tons produced.
Reference: Arizona Bureau of Mines Bull. 1980, 1969.

191. Lake Pleasant Diatomite Occurrence
Location: Sec. 24, T7N, R1E, location very approximate
Commodity: Diatomite
Geology: Deposit associated with local exposures of Cenozoic lake beds.
Production: Yes, small amount in 1964
Reference: Arizona Bureau of Mines Bull. 180, 1969.

192. Aqua Fria District Placers
Location: T8N, R2 and 3E
Commodity: Au
Deposit Description: Placer.
Production: Yes, about 50 oz. recovered.
Reference: USGS, Bull. 1355, 1972.

193. New River District Placers
Location: T6, 7N, R2, 3E
Commodity: Au
Deposit Description: Placer deposits.
Production: Yes, small amount.
Reference: USGS, Bull. 1355, 1972.

194. Humbug District Placers
Location: T8N, R1W (general location for several placers)
Commodity: Au
Deposit Description: Placer.
Geology: Gravel bars, source from lode gold veins that intersect and offset rhyolite porphyry dikes.
Production: Yes, about 1500 oz. for district.
Reference: USGS, Bull. 1355, 1972.

195. Squaw Creek Placers
Location: T9N, R2E
Commodity: Au
Deposit Description: Placers.
Production: Yes, about 7 oz.
Reference: USGS, Bull. 1355, 1972.

201. Unnamed Thermal Well
Location: NE1/4 sec. 15 T8N, R1W
Temperature: 44°C
Well Depth: 500 meters
Reference: Witcher, Stone and Hahman, Sr., 1982

202. Castle Hot Springs Area
Location: S1/2 T8N, R1W N1/2, T7N, R1W
Description: Low temperature thermal area containing 3 hot springs.
Name: Castle Hot Springs
Location: SE1/4, sec. 33, T8N, R1W
Temperature: 55°C
Flow Rate: 1287 liters/min
Name: Alkalai Spring
Location: SW1/4, sec. 33, T8N, R1W
Temperature: 31°C
Name: Henderson Ranch Spring
Location: NW1/4, sec. 33, T8N, R1W
Temperature: 30°C
References: Witcher, Stone and Hahman, Sr., 1982.

Known Prospects, Mineralized Areas and Geothermal Resources with No Recorded Production

1. Renfro Antimony Prospect
Location: Sec. 15 (?), T8N, R2E
Commodity: Sb
Deposit Description: Vein, underground workings
Geology: Host rock schistose granite porphyry
Production: No production
Reference: USGS, 1972, revised 1981, CRIB Mineral Resources File 12, Record 872, p. 2323-2324.

3. Pikes Peak
Location: Sec. 24,25, T6N, R2W
Commodities: Fe, Mn
Deposit Description: Lenticular deposits in schist, workings both surface and underground, 20,000,000 tons estimated workable low grade ore.
Geology: Mineralization in schist.
Production: Unknown.
References: USGS, 1972, revised 1981, CRIB Mineral Resources File 12, Record 815, p. 2197-2198; Stipp, et. al., 1967; Arizona Bureau of Mines Bull. 180, 1969.

4. Blue Bell - Jubilee Occurrence
Location: 34°19´40"N, 112°14´41"W
Sec. 15, 22, T11N, R1E
Commodity: Fe
Ore Materials: Magnetite, hematite
Deposit Description: Linear band in bedded sediments, small deposit 2 miles in length, 300 feet maximum width, ore body strikes N20°E and dips 75°NW.

Geology: Precambrian Yavapai schist, taconite, mineralization occurs within amphibolitic tuff, agglomerate, quartzite, graywacke, and argillite.
Production: No production.
Reference: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2424, p. 6084-6085.

10. De Soto Magnetite Occurrence
Location: 34°17´28"N, 112°17´27"
Sec. 31,32, T11N, R1E
Commodity: Fe
Ore Materials: Magnetite, hematite, limenite
Deposit Description: Linear bands in bedded sediments, small ore body 100 feet wide striking N23° dipping 70°NW.
Geology: Mineralization in Precambrian Yavapai schist-taconite.
Production: No production.
Reference: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2430, p. 6102-6103.

15. Blind Indian-Arrastra Creek-Longfellow Ridge Occurrence
Location: 34°18´39"N, 112°22´57W"
Sec. 8, T11N, R1W, (location very approximate)
Commodity: Fe
Ore Material: Magnetite
Deposit Description: Linear bands in bedded sediments, small deposit 2 miles in length and 500 feet in width, striking N10°E and dipping 75°NW.
Geology: Mineralization in Precambrian hornblende Yavapai schist-taconite.
Production: No production.
References: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2435, p. 6116-6117.

56. Wasson Peak - Orobelle Occurrence
Location: 34°10´24"N, 112°21´23"W
Sec. 34,T10N, R1W
Commodity: Fe
Ore Material: Magnetite
Deposit Description: Bedded, striking N and vertical dip.
Geology: In Precambrian Yavapai schist.
Production: No production.
Reference: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2401, p. 6013-6014.

58. Bland Prospect
Location: 34°13´6"N, 112°10´15"W
Sec. 29, T10N, R2E
Commodity: Au

Ore Material: Gold
Deposit Description: Small vein.
Geology: Mineralization vein of gold and pyrite in Precambrian quartz diorite.
Production: No production.
References: USGS, 1972, updated 1979, CRIB Mineral Resources File 12, Record 2403, p. 6018-6020; Stipp et. al., 1967.

59. Howard Copper Mine
Location: 34°12′40"N, 112°11′30"W
SW1/4 sec. 30, T10W, R2E
Commodities: Cu, Au, Ag
Ore Materials: Chalcopyrite, pyrite
Deposit Description: Stratiform massive sulfide, lense shaped 560 feet in length, 558 feet in width, 30 feet in thickness. Striking N and dipping 85°W. Underground workings.
Geology: Massive sulfide lens in Precambrian metarhyolite.
Production: Unknown.
Reference: USGS, 1981, CRIB Mineral Resources File 12, p. 6021-6023.

60. Black Canyon Occurrence
Location: 34°11′53"N, 112°11′34"W
Sec. 31, T10N, R2E
Commodity: Fe
Ore Materials: Magnetite, hematite
Deposit Description: Bedded sediments in linear band, 1 mile in length, 1000 feet in width, and 200 feet thick. Dips 85°W.
Geology: Precambrian Yavapai schist.
Production: No production.
Reference: USGS, 1979, CRIB Mineral Resources File 12, Record 2405, p. 6024-6025.

62. Hidden Treasure Mine
Location: 34°15′13"N, 112°10′44"W
SE1/4 SE1/4 sec. 7, SW1/4 SW1/4 sec. 8, T10N, R2E
Commodities: Au (major); Ag (minor); Pb, Zn, Cu (potential)
Ore Materials: Gold, chalcopyrite
Deposit Description: Vein, shear zone, lens and tabular, 350 feet in length, 300 feet in width, 5 feet thick, dipping 70° east. Underground workings.
Geology: Vein cuts Precambrian granodiorite.
Production: Undetermined
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2407, p. 6030-6032.

65. "Smokey´s" - Copper Basin

Location: 34°8´8"N, 112°20´30"W
Sec. 10,11, T9N, R1W
Commodities: Cu, Mo
Ore Materials: Molybdenite, chalcopyrite
Deposit Description: Disseminated copper molybdenum deposit.
Geology: Precambrian quartz monzonite, Tertiary (?) granite pegmatite, rhyolite, small porphyry deposits spatially related with rhyolite dike swarms.
Production: No.
Reference: USGS, 1974, updated 1981, CRIB Mineral Resources File 12, Record 2349, p. 5857-5859.

67. Jonell Prospect

Location: 34°5´7"N, 112°24´21"W
Sec. 30,31, T9N, R1W
Commodity: W
Ore Materials: Scheelite, wolframite
Deposit Description: Dike, vein, 1 inch stringer strikes N45°E and dips 75°NW and contains scheelite and wolframite. Scheelite is also thinly scattered over an area over 1 mile long and a few hundred feet wide. Surface workings.
Geology: Mineralization in Precambrian gabbro dike, Precambrian schist.
Production: No.
Reference: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2351, p. 5863-5864.

69. Nigger Brown Prospect

Location: 34°9´14"N, 112°9´27"W
Sec. 4, T9N, R2E
Commodity: Au
Ore Materials: Free gold, sulfides
Deposit Description: Small vein, 2 feet in width, dipping to SE. Underground workings.
Geology: Quartz-pyrite vein in Precambrian quartz diorite.
Production: No.
Reference: USGS, 1972, updated 1979, 1982, CRIB Mineral Resources File 12, Record 2353, p. 5868-5870.

70. Gillespie Mine

Location: 34°7´27"N, 112°9´48"W
NW1/4 sec. 16, T9N, R2E
Commodity: Au
Ore Material: Gold
Deposit Description: Vein, tabular, small deposit with underground workings.
Geology: Quartz-pyrite vein in Precambrian quartz diorite.

Production: Unknown.
Reference: USGS, 1981, CRIB Mineral Resources File 12, Record 2354, p. 5871-5873.

73. Joyce K. Prospect
Location: 34°6´53"N, 112°26´28"W
Sec. 14, T9N, R2W
Commodity: W
Ore Material: Scheelite
Deposit Description: Metamorphic, maximum width 6 inches, striking N85°E, dipping 70°N. Underground workings.
Geology: Scheelite in thin coatings along schistosity planes in Precambrian schist.
Production: No.
References: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2357, p. 5880-5882, Stipp et. al., 1967.

96. Dahlia Prospect
Location: 34°3´57"N, 112°25´49"W
Sec. 2, T8N, R2W
Commodity: W
Ore Material: Scheelite
Deposit Description: Vein, pinch and swell, discontinuous small deposit, 200 feet in length and 4 feet in width. The ore body strikes N40°E and dips 70°NW. Surface workings.
Geology: Host rock Precambrian schist.
Production: No.
References: USGS, 1979, updated 1982, CRIB Mineral Resources File 12, Record 2324, p. 5783-5784; Stipp et. al. 1967.

99. Black Butte Prospect
Location: 34°1´13"N, 112°28´39"W
Sec. 20, T8N, R2W
Commodities: W, Mn
Ore Materials: Scheelite, hollandite (?), psilomelane, pyrolusite
Deposit Description: Vein, shear zone, small deposit, 2 feet in width, strikes N20°E and dips 82°SE. Surface and underground workings.
Geology: Host rock Precambrian schist, pegmatite dikes.
Production: No.
Reference: USGS, 1979, CRIB Mineral Resources File 12, Record 2327, p. 5791-5793.

106. Unnamed Granite Occurrence
Location: Sec. 1, 12, T11N, R1W
Commodity: bs
Production: Unknown
Reference: McCrory and O´Haire, 1965.

107. Unnamed Kyanite, Andalusite, Sillimanite Occurrence
Location: Sec. 29, T11N, R1E
Commodity: ky
Production: Unknown.
Reference: McCrory and O'Haire, 1965.

108. Unnamed Chrysocolla Occurrence
Location: Sec. 7,18, T10N, R1E
Commodity gs
Production: Unknown.
Reference: McCrory and O'Haire, 1965.

109. Luke's Hoist Area
Location: Sec. 28, T10N, R1W
Commodities: Mica, Be
Deposit Description: Pegmatite lenses up to 50 feet in width.
Geology: Poorly zoned pegmatite.
Production: Unknown.
References: McCrory and O'Haire, 1965; Arizona Bureau of Mines Bull. 180, 1969.

110. Unnamed Schist Occurrence
Location: Sec. 19, T9N, R2W
Commodity: bs
Production: Unknown.
Reference: McCrory and O'Haire, 1965.

111. French Creek Deposit
Location: Sec. 29,32, T9N, R1W
Commodity: Ba
Production: Unknown.
References: McCrory and O'Haire, 1965; Arizona Bureau of Mines Bull. 180, 1969.

112. Unnamed Mica Occurrence
Location: Sec. 16,15,21,22, T8N, R2W
Commodity: mi
Production: Unknown.
Reference: McCrory and O'Haire, 1965.

113. Independence Mine
Location: Sec. 29, T8N, R2W
Commodities: Li, Be
Ore Materials: Beryl, lithium minerals
Deposit Description: In irregular dikes.
Geology: Mineralization in dikes that cut schist
Production: Unknown.
References: McCrory and O'Haire, 1965; Arizona Bureau of Mines Bull. 180, 1969.

114. Unnamed Lithium Minerals Occurrence
Location: Sec. 30, T8N, R2W
Commodity: Li
Production: Unknown.
Reference: McCrory and O'Haire, 1965.

115. Unnamed Schist Occurrence
Location: Sec. 1, T7N, R2E
Commodity: bs
Production: Unknown.
Reference: McCrory and O´Haire, 1965.

116. Unnamed Dolomite Occurrence
Location: Sec. 8,9, T7N, R1E
Commodity: ls
Production: Unknown.
Reference: McCrory and O´Haire, 1965.

117. Unnamed Mica Occurrence
Location: Sec. 4,5, T6N, R2W
Commodity: mi
Production: Unknown.
Reference: McCrory and O´Haire, 1965.

118. Unnamed Opal, Agate, Petrified Wood, etc. Occurrence
Location: Sec. 33,34, T7N, R1W
Commodity: gs
Production: Unknown.
Reference: McCrory and O´Haire, 1965.

119. Unnamed Turquoise Occurrence
Location: Sec. 15,22, T6N, R2W
Commodity: gs
Production: Unknown.
Reference: McCrory and O´Haire, 1965.

120. Unnamed Jasper Occurrence
Location: Sec. 27,34, T6N, R3E
Commodity: gs
Production: Unknown.
Reference: McCrory and O´Haire, 1965.

121. Unnamed Columbium and Tantalum Occurrence
Location: Sec. 31, T8N, R2W
Commodity: Nb
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

122. P and G Beryl Claim
Location: Sec. 34, T8N, R2W
Commodity: Be
Ore Material: Beryl
Deposit Description: In dikes.
Geology: Beryl in small pegmatite dikes
Production: Unknown.
References: Stipp, Haigler, Alto and Sutherland, 1967;
Arizona Bureau of Mines Bull. 180, 1969.

123. Unnamed Copper Occurrence
Location: Sec. 34, T8N, R1W
Commodity: Cu
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

124. Unnamed Copper Occurrence
Location: Sec. 32, T8N, R1E
Commodity: Cu
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

125. Unnamed Lead Occurrence
Location: Sec. 21, T7N, R1W
Commodity: Pb
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

126. Unnamed Gem and Ornamental Stone Occurrence
Location: Sec. 33, T7N, R1W
Commodity: gs
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

127. Unnamed Manganese Occurrence
Location: Sec. 19,30, T7N, R1E
Commodity: Mn
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

128. Unnamed Copper Occurrence
Location: Sec. 16, T7N, R3E
Commodity: Cu
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

129. Unnamed Copper and Gold Occurrence
Location: Sec. 36, T7N, R3E
Commodities: Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

130. Unnamed Gold Occurrence
Location: Sec. 29, T11N, R1W
Commodity: Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

131. Unnamed Tungsten Occurrence
Location: Sec. 2, T6N, R2W
Commodity: W
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

132. Unnamed Copper and Gold Occurrence
Location: Sec. 21, T6N, R2W
Commodities: Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

133. Unnamed Gem and Ornamental Stone Occurrence
Location: Sec. 22, T6N, R2W
Commodity: gs
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

134. Unnamed Manganese Occurrence
Location: Sec. 26, T6N, R2W
Commodity: Mn
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

135. Unnamed Lead Occurrence
Location: Sec. 30, T6N, R1W
Commodity: Pb
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

136. Unnamed Iron Occurrence
Location: Sec. 9, T6N, R1W
Commodity: Fe
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

137-138. Unnamed Copper Occurrence
Location: 137: Sec. 1, T6N, R2E
138: Sec. 6, T6N, R2E
Commodity: Cu
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

139. Unnamed Silver, Copper and Gold Occurrence
Location: Sec. 6, T8N, R2W
Commodities: Ag, Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

140. Unnamed Copper and Gold Occurrence
Location: Sec. 8, T8N, R2W
Commodities: Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

141. Unnamed Silver Occurrence
Location: Sec. 14, T8N, R2W
Commodity: Ag
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

142. Unnamed Mica Occurrence
Location: Sec. 10,15, T8N, R2W
Commodity: mi
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

143. Unnamed Feldspar Occurrence
Location: Sec. 26,25, T8N, R2W
Commodity: fs
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

144. Unnamed Copper Occurrence
Location: Sec. 28, T8N, R1W
Commodity: Cu
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

145. Unnamed Molybdenum and Gold Occurrence
Location: Sec. 28, T11N, R1W
Commodities: Mo, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

146. Unnamed Beryllium Occurrence
Location: Sec. 5, T8N, R1E
Commodity: Be
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

147. Unnamed Tungsten Occurrence
Location: Sec. 4,5, T8N, R1E
Commodity: W
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

148. Unnamed Silver and Gold Occurrence
Location: Sec. 4, T8N, R1E
Commodities: Ag, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

149. Unnamed Tungsten Occurrence
Location: Sec. 17, T8N, R1E
Commodity: W
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

150. Lone Giant Mine
Location: Sec. 19, T8N, R2E
Commodities: Be, Li
Ore Materials: Beryl and lithium minerals
Deposit Description: Pegmatite.
Geology: Beryl and lithium minerals in lenticular zoned pegmatite and schist.

Production: Unknown.
References: Stipp, Haigler, Alto and Sutherland, 1967; Arizona Bureau of Mines Bull. 180, 1969.

151. Unnamed Silver, Copper and Gold Occurrence
Location: Sec. 4, T8N, R2E
Commodities: Ag, Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

152. Unnamed Mineral Occurrence
Location: Sec. 19, 30, T8N, R3E
Commodities: Unknown.
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

153. Unnamed Tungsten Occurrence
Location: Sec. 32, T9N, R2W
Commodity: W
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

154. Unnamed Mineral Occurrence
Location: Sec. 23,26, T9N, R2W
Commodities: Unknown.
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

155. Unnamed Gold Occurrence
Location: Sec. 1, T9N, R2W
Commodity: Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

156. Unnamed Copper and Gold Occurrence
Location: Sec. 18, T9N, R1W
Commodities: Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

157. Unnamed Silver, Copper and Gold Occurrence
Location: Sec. 9, T9N, R1W
Commodities: Ag, Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

158. Unnamed Lead and Zinc Occurrence
Location: Sec. 15, T9N, R1W
Commodities: Pb, Zn
Production: Unknown.
References: Stipp, Haigler, Alto and Sutherland, 1967.

159. Unnamed Lead and Zinc Occurrence
Location: Sec. 24, T9N, R1W
Commodities: Pb, Zn
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

160. Unnamed Barite Occurrence
Location: Sec. 32, T9N, R1W
Commodity: Ba
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

161. Unnamed Mineral Occurrence
Location: Sec. 29, T9N, R2E
Commodities: Unknown.
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

162. Unnamed Manganese Occurrence
Location: Sec. 26, T9N, R2E
Commodity: Mn
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

163. Unnamed Gold Occurrence
Location: Sec. 10,11, T9N, R2E
Commodity: Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

164. Unnamed Mineral Occurrence
Location: Sec. 2, T9N, R2E
Commodities: Unknown.
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

165. Unnamed Mineral Occurrence
Location: Sec. 28, T10N, R2W
Commodities: Unknown.
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

166. Juniper Group
Location: Sec. 23, 26, T10N, R1W
Commodity: Be
Ore Material: Beryl
Deposit Description: Pegmatite.
Geology: Elongate zoned pegmatite masses cutting granite.
Production: Unknown.
References: Stipp, Haigler, Alto and Sutherland, 1967; Arizona Bureau of Mines Bull. 180, 1969.

167. Unnamed Lead and Copper Occurrence
Location: Sec. 31, T10N, R1E
Commodities: Pb, Cu
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

168. Unnamed Iron Occurrence
Location: Sec. 14,23, T10N, R1E
Commodity: Fe
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

169. Unnamed Bismuth Occurrence
Location: Sec. 12,13, T10N, R1E
Commodity: Bi
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

170. Unnamed Manganese Occurrence
Location: Sec. 1, T10N, R1E
Commodity: Mn
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

171. Unnamed Lead, Copper and Gold Occurrence
Location: T-9-1/2N, R2E
Commodities: Pb, Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

172. Unnamed Silver, Copper and Gold Occurrence
Location: Sec. 30, T10N, R2E
Commodities: Ag, Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

173. Unnamed Tungsten Occurrence
Location: Sec. 19, T10N, R2E
Commodity: W
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

174-175. Unnamed Mineral Occurrence
Location: 174: Sec. 1, T10N, R2E
175: Sec. 5, T10N, R2E
Commodities: Unknown.
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

176. Unnamed Silver, Copper and Gold Occurrence
Location: Sec. 6, T10N, R2E
Commodities: Ag, Cu, Au
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

178. Unnamed Manganese Occurrence
Location: Sec. 30, T11N, R3E
Commodity: Mn
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

179. Unnamed Iron Occurrence
Location: Sec. 31, 32, T11N, R2W
Commodity: Fe
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

180. Unnamed Tungsten Occurrence
Location: Sec. 35, T11N, R1E
Commodity: W
Production: Unknown.
Reference: Stipp, Haigler, Alto and Sutherland, 1967.

181. Unnamed Mineral Occurrence
Location: Sec. 35, T11N, R1W
Commodities: Unknown.
Production: Unknown.
References: Stipp, Haigler, Alto and Sutherland, 1967.

182. Big Reef Claims
Location: Sec. 3, T7N, R3W (location very approximate)
Commodity: Be
Ore Material: Beryl
Deposit Description: Pegmatite dike.
Geology: Beryl in lenticular, locally zoned pegmatite dike in schist.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 180, 1969.

183. Berry´s Wonder Claim
Location: Sec. 21,22, T9N, R2W (location very approximate)
Commodity: Be
Ore Materials: Beryl and apatite
Deposit Description: Pegmatite.
Geology: Elongate zoned pegmatite.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 180, 1969.

184. B. O. Beryl Claims
Location: Sec. 21, T9N, R2W (location very approximate)
Commodity: Be
Ore Material: Beryl
Deposit Description: Pegmatite.
Geology: 10 foot thick partly zoned pegmatite masses that cut granite.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 180, 1969.

185. Phenacite King
Location: Sec. 4, T10N, R1E (location very approximate)
Commodity: Be
Deposit Description: Pegmatite pod 150 feet in length and 15 feet wide.
Geology: Unzoned pegmatite.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 180, 1969.

186. White Rock
Location: Sec. 26, T11N, R1E (location very approximate)
Commodity: Be
Deposit Description: Pegmatite, up to 50 feet in diameter.
Geology: Zoned irregular pegmatite.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 180, 1969.

187. Rock Springs
Location: Sec. 17, T9N, R2E (location very approximate)
Commodity: Fe
Deposit Description: Taconite like iron formation.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 180, 1969.

189. Willbanks Prospect
Location: Sec. 15, T8N, R1W (location very approximate)
Commodity: Th
Deposit Description: Dike.
Geology: Mafic dike cuts fine grained granite Th associated with limonite, hematite, and barite.
Production: Unknown.
References: Arizona Bureau of Mines, Bull. 180, 1969;
Arizona Bureau of Mines, Bull. 182, 1970.

190. Horseshoe Group
Location: Sec. 18, T7N, R3E (location very approximate)
Commodity: U
Deposit Description: Mineralized gouge in near verticle fault
Geology: In NE-SW trending fault cutting granite.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 180, 1969.

196. Golden Duck Group
Location: E Central Sec. 19, T7N, R2W
Commodities: U (major); Cu (minor)
Ore Materials: Torbernite schroekingite, chrysocolla
Deposit Description: In Rhyolite tuffs, some mineralization in shear fractures.
Geology: Mineralization in rhyolite tuff member of Tertiary volcanic series of pyroclastics and flows with basal arkosic conglomerate covering Precambrian complex.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 182, 1970.

197. Los Cuatros Group
Location: SE1/4, T6N, R3E (approximate)
Commodity: U
Deposit Description: In thin volcanic ash bed
Geology: Mineralization in thin, crenulated volcanic ash bed below silicified volcanic ash of Tertiary age.
Production: Unknown.
References: Arizona Bureau of Mines, Bull. 182, 1970; USGS Open File Report 79-1429, 1979.

198. Little Surprise
Location: SE1/4 sec. 33, T11N, R1E
Commodity: U
Ore Materials: Torbernite (?)
Deposit Description: Vein.
Geology: Small quartz-barite vein with copper staining cutting Precambrian rocks.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 182, 1970.

199. Ford Claim
Synonym Name: Gazelle Mine
Location: NE1/4 sec. 33, T10N, R1W
Commodity: U
Ore Materials: Torbernite and uranophane
Deposit Description: Small quartz stringers in fault carrying base metals and silver.
Production: Unknown.
Reference: Arizona Bureau of Mines Bull. 182, 1970.

200. Black Donkey Group
Location: Sec. 4, T8N, R1W
Commodity: U
Ore Materials: Limonite, autonite
Deposit Description: Quartz calcite vein in shear zone.
Geology: Shear zone in Precambrian complex.
Production: Unknown.
Reference: Arizona Bureau of Mines, Bull. 182, 1970.

203. Vision Burnbrite Claims
Location: NE1/4 sec. 21, T7N, R1W
Commodities: Ag, Cu
Ore Materials: Silver bearing chalcocite, copper carbonates and oxides.
Deposit Description: Vein disseminated copper. Surface and underground workings.
Geology: In quartz monzonite porphyry.
Production: None.
Reference: F.X. Cannaday, written comm. 1982.

204. Unnamed Uranium Occurrence
Location: SW1/4 sec. 23, T7N, R1E
Commodity: U
Ore Materials: Carnotite
Deposit Description: 2-3X background.
Geology: Tuff limestone series depositional on Yavapai series, tuff beds reworked 2-4 feet thick, interbedded limestones 2-20 feet thick, carnotite in fractures.
Production: None.
Reference: Scarborough and Wilt, 1979.

205. Unnamed Uranium Occurrence
Location: NE1/4 sec. 21, T7N, R1E
Commodity: U
Ore Materials: Carnotite
Deposit Description: 3X background.
Geology: Fine grained basin fill mudstone, fluvial overbank origin.
Production: None.
Reference: Scarborough and Wilt, 1979.

206. Unnamed Uranium Occurrence
Location: SE1/4 of SE1/4, sec. 32, T7N, R3E
Commodity: U
Deposit Description: 2-5X background, uranium mineralization disseminated in dolomite.
Geology: Assemblange of 2 foot thick dolomite beds rhythmically bedded with calcareous mudstones which are underlain by andesite flows.
Production: None.
Reference: Scarborough and Wilt, 1979.

Mining Claims, Leases, and Material Sites

The most important details pertaining to the mining claims density (number of claims per square mile) in the Hot Springs GRA, and other relevant records are summarized in Table 3 and are shown in figure 5. Additionally, in figure 5, locations and number of potential claims are also shown. All data was obtained from and are reported after the BLM´s records as of June, 1982.

During this study we have also thoroughly investigated the status of oil and gas leases. As a result, an outline of all land currently either fully or partially leased within, and in close proximity of, each specific

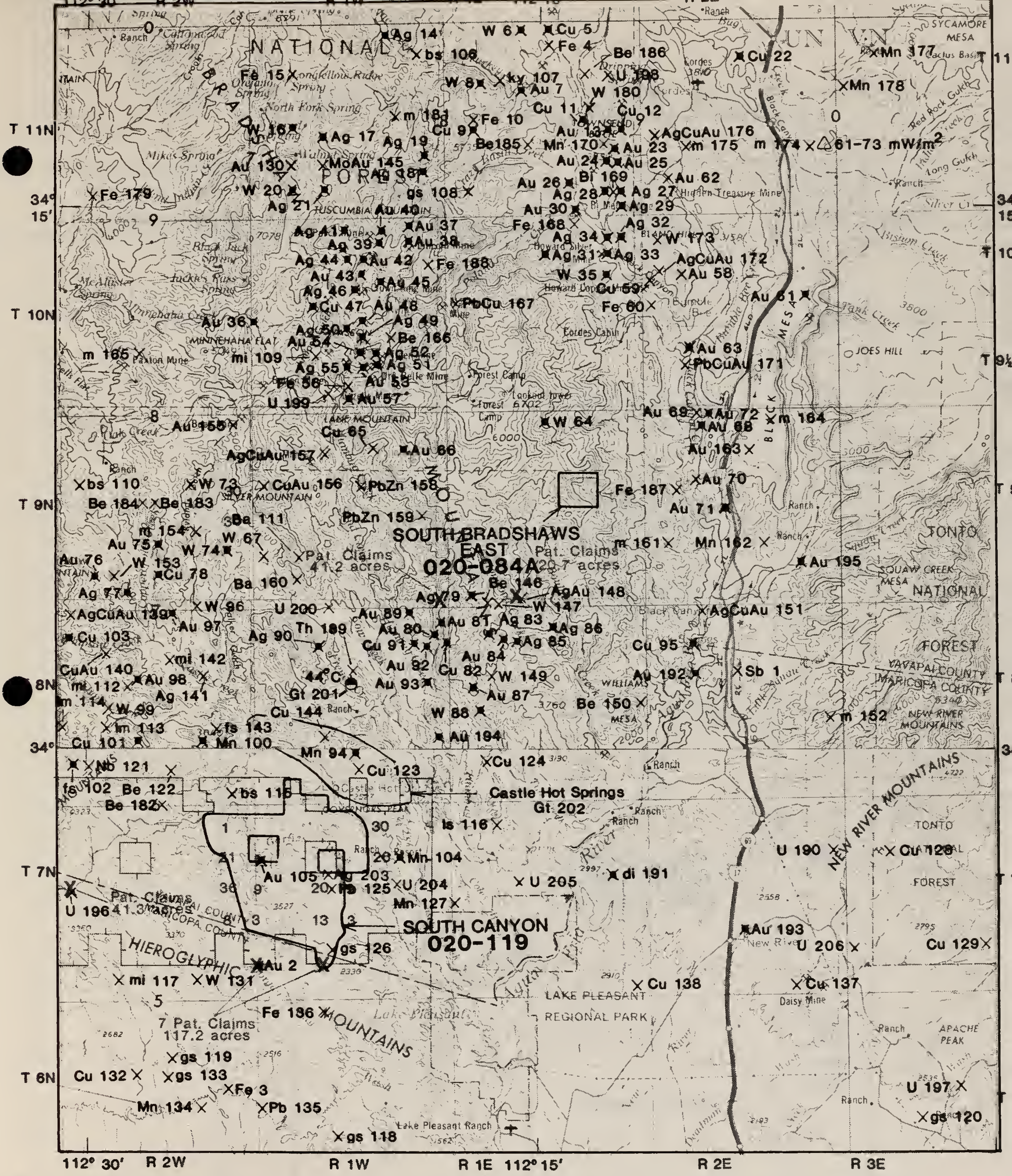


Figure 5 CLAIM DENSITY MAP, WITH OIL AND GAS LEASING STATUS, OF THE HOT SPRINGS AREA, ARIZONA.
Note: hachured lines enclose oil and gas leases; numbers are claims per section.

TABLE 3

CLAIM DENSITY RECORDS IN THE WILDERNESS STUDY AREAS (WSA), HOT SPRINGS GRA ACCORDING TO BLM (JUNE 1982), ARIZONA STATE OFFICE

Township	Range	Section	Claims For Each Section	Claimants	Latest Assmt. Date	Remarks
WSA 020-119 South Canyon						
7N	1W	11	All 1	Hunt Oil Co.	1981	lode
			E2 1	"	"	"
			N2 4	"	"	"
			NE 4	"	"	"
			S2 6	Hunt Oil Co./ Inlow, Dudley	"	"
			SE 14	"	"	"
		14	N2 5	"	"	"
			NE 8	Hunt Oil Co./ Inlow, Dudley/ Burtner, Sam	"	"
			SE 5	Hunt Oil Co./ Horn, Wanda	"	"
			All 1	Hunt Oil Co.	"	"
			S2 5	"	"	"
			E2 1	"	"	"
			NW 1	"	"	"
		18	W2 1	Jordanov, Jordan	none	"
			SW 4	"	"	"
		19	W2 1	"	"	"
			NW 5	"	"	"
			SW 3	"	"	"
		21	S2 1	Simonson, Mike	1982	"
			E2 2	Simonson, Mike/ Kellogg, John	"	"
			W2,SE 1	"	"	"
			SW 2	"	"	"
			SE 13	"	"	"
			NE 1	"	"	"
		22	All 1	"	none	"
			W2 2	"	1982	"
			S2 1	"	none	"
			SW 4	"	1982	"
			SE 1	Simonson, Mike	"	"

TABLE (Cont'd.)

Township	Range	Section	Claims For Each Section	Claimants	Latest Assmt. Date	Remarks
WSA 020-119 South Canyon (Cont'd.)						
7N	1W	27	N2 2	Simonson, Mike/ Kellogg, John	none	lode
			NE 1	"	1982	"
		28	N2 2	"	"	"
			NW 5	"	"	"
			NE 6	"	"	"
		30	SW 1	Boyle, Jamie	1981	"
			SE 2	Cover, Cliff	none	"
7N	2W	12	SW 1	Jordan, Marvin	1981	placer
		13	S2 5	Jordanov, Jordan	none	lode
			SW 5	"	"	"
			SE 10	"	"	"
			NW 1	Jordan, Marvin	1981	placer
		24	All 1	Jordanov, Jordan	none	lode
			N2 4	"	"	"
			S2 4	"	"	"
			W2 1	"	"	"
			E2 2	"	"	"
			NW 4	"	"	"
			SW 4	"	"	"
			NE 8	"	"	"
			SE 8	"	"	"
		25	NE 8	Jordanov, Jordan/ Vasilev, Spasen/ Gospodinov, Borislav/ Cvetkov, Gene	"	"
WSA 020-084A South Bradshaw East						
9N	2W	13	N2 2	Carpenter, Woodrow/ Russell, C.J.	1981	lode
			S2 2	"	"	"
			W2 5	Russell, Frank/ Medd, George Jr.	none	"

TABLE (Cont'd.)

Township	Range	Section	Claims For Each Section	Claimants	Latest Assmt. Date	Remarks
WSA 020-084A South Bradshaw East (Cont'd.)						
9N	2W	13	NW 11	Carpenter, Woodrow/ Russell, C.J./ Medd, George Jr.	1981	lode
			SW 10	"	"	"
		24	All 1	McKibben, H.M.	none	"
			W2 4	"	"	"
			NE 2	"	1981	"
			SW 10	"	none	"
			S2 1	McDonald, Adelaide	1981	"
			SE 7	"	"	"
			E2 5	McKibben, H.M./ McDonald, Adelaide	"	"

WSA of the Hot Springs GRA is shown together with the claim density (see fig. 5). Much of the federal and fee land is leased for oil and gas exploration for five or ten year terms.

Many claims, none patented, are located within the South Canyon (020-119) WSA. Much of the WSA is leased for oil and gas. No claims or oil leases are located within the South Bradshaws East (020-084A) WSA. No information is available about commodities present in the claimed land.

Mineral Deposit Types

Geological environments to be considered as potentially favorable for the occurrence of mineral or energy resources include the following:

Older Precambrian metamorphic rocks (Yavapai Series)
Older Precambrian granitic rocks
Laramide intrusives
Mid-Tertiary volcanic rocks
Mid-Tertiary basin-fill sediments
Late Tertiary basin-fill sediments
Recent alluvium
Active geothermal systems

Table 4 lists these geological environments in relation to types of mineral deposits.

Older Precambrian Metamorphic Rocks

Numerous occurrences of massive sulfide deposits are found in Precambrian rocks in Arizona. They are invariably associated with submarine rhyolitic volcanism (Donnelly and Hahn, 1981), and are either of the proximal or distal type (Anderson and Guilbert, 1979). The proximal deposits are copper- and locally zinc-rich and were formed above or on the flanks of rhyolitic centers; the distal ones are zinc- and relatively lead-rich, contain silver and gold and were formed at the same time as the proximal deposits, but

Table 4. GEOLOGICAL ENVIROMENTS OF THE HOT SPRINGS AREA AND ASSOCIATED POTENTIAL MINERAL DEPOSIT TYPES

MINERAL DEPOSIT TYPE GEOLOGICAL ENVIROMENT – HOST ROCKS	Volcanogenic Massive Sulfide Deposits	Hydrothermal Deposits (including replacement deposits)	Porphyry–Type Deposits	Tin–Tungsten Deposits (S–Type Granite)	"Red–Bed" Type Deposits	Placer Deposits	Uranium Deposits (all types)	Geothermal Deposits
Active Geothermal Systems								X
Tertiary and Quaternary Alluvium						X	X	
Mid– and Late Tertiary Basin–Fill Sediments							X	
Mid–Tertiary Volcanic Rocks		X						
Laramide Intrusive Rocks		X	X					
Older Precambrian Igneous and Metamorphic Rocks	X			X				

in an adjacent basin. The massive sulfide deposits are associated with banded iron formations which are zoned, with sulfide facies near the rhyolitic center and carbonate and oxide facies more distant (Anderson and Guilbert, 1979). Felsic metavolcanic rocks occur within the Yavapai Series, which lie to the northwest of the Holbrook Line (see fig. 2A). To the south of the Holbrook Line lie the Pinal Schists which are generally non-volcanogenic. Most of the ore produced from massive sulfide deposits in Arizona came from the Jerome area to the north of the GRA. Here the United Verde and United Verde Extension deposits (both proximal) produced 30 and 4 million tons of ore, respectively. In contrast, the production from all other massive sulfide deposits in Arizona totals only 9 million tons of ore (Donnelly and Hahn, 1981).

Within the GRA eleven named massive sulfide deposits are known. Proximal types include Pentland, Hackberry, Blue Bell, DeSoto and New River; distal types include Peck, Swastika, Gladiator, Golden Belt, Kay and Orizaba. Of these the Blue Bell deposit produced the most ore at 2 million tons.

Some scheelite ± wolframite veins may also be of Precambrian age. Occurrences 35 and 74 are associated with Precambrian granitic pegmatites and aplites. Occurrences 16 and 20 are also close to Precambrian intrusive contacts and could be associated with Precambrian plutonism.

Laramide Intrusives

The Laramide was a time of emplacement in all but one (Bisbee) of the porphyry copper deposits in Arizona and adjacent New Mexico and Mexico. Of the 35 major porphyry copper deposits in this region, 32 lie to the south of the Holbrook Line, where basement is Pinal Schist and three lie to the northwest where basement consists of Yavapai Series and gneissic-metavolcanic terrain (see fig. 2A). The intrusives associated with the porphyry copper deposits were emplaced during the westward sweep of the magmatic arc

(Damon et al., 1981; Clark, et al., 1982), possibly related to the decrease in the dip of the Benioff zone at this time (Coney and Reynolds, 1977). The porphyry copper deposits appear to be aligned along northwest and east-northeast trends (see fig. 2C; Heidrick and Titley, 1982). The northwesterly trend is sub-parallel to Mesozoic linear discontinuities in depositional patterns (Titley, 1976); the trend of Laramide basement-cored uplifts and thrust faults (Nielsen, 1979; Davis, 1981); the Texas zone of Schmitt (1966); and the trend of the Laramide magmatic arcs. The ENE trend is subparallel to Precambrian fold axes and to Laramide tensional features (Rehrig and Heidrick, 1976). The intrusions related to the porphyry copper deposits are small in area (seldom over 3 km^2) and may have been emplaced along the NW and ENE structural intersections.

The Hot Springs GRA lies entirely within the major northwest-trending zone of porphyry copper deposits, and a subsidiary ENE-trending zone cuts across the northern half of the GRA (see fig. 2C). However, it is entirely underlain by Yavapai Series basement, a region where major porphyry copper deposits are rare. In fact only 3 out of 35 major porphry copper deposits in the southwest lie outside the area underlain by Pinal Schist.

At least 17 hydrothermal deposits are associated with Laramide intrusives in the GRA (occurrences 7, 17, 21, 26, 37, 38, 39, 41, 42, 43, 45, 47, 49, 50, 51, 52, 57). These occurrences lie within the north-central part of the GRA, where the ENE- and NW-trending zones overlap. The deposits occur within Precambrian schist and granite and are associated with small Laramide granodioritic plutons. They occur largely as veins along shears but occurrence 47 contains disseminated mineralization in a breccia pipe. Most of the occurrences carry Au, Ag, Cu, Pb and Zn, but occurrence 37 also carries Mo. The most important primary minerals are pyrite, chalcopyrite, sphalerite, galena and, less commonly, tetrahedrite, chalcocite, argentite, barite and ankerite. Only minor production has taken place from the above deposits.

Mid-Tertiary Volcanic Rocks

Mid-Tertiary volcanics in southern Arizona, southwestern New Mexico and Mexico are associated with gold/silver and base metal lode deposits (Damon et al., 1981; Clark et al., 1982). The volcanics were erupted when the magmatic arc swept rather rapidly westward, possibly as a result of the steepening of the Benioff zone (Coney and Reynolds, 1977). In southwestern New Mexico the deposits are associated with cauldrons from which voluminous ignimbrites and other volcanics were erupted (Elston, 1978). As yet, no such cauldrons have been identified in Arizona, but the voluminous ignimbrites and presence of numerous deposits suggest that such cauldrons could be present. In the Hot Springs GRA, mid-Tertiary volcanics are not extensive. If cauldrons were ever present in the area, they have been largely eroded away.

Within the Hot Springs GRA at least 33 deposits appear to be associated with mid-Tertiary epizonal plutonism and volcanism (occurrences 13, 14, 24, 27, 28, 29, 34, 46, 48, 53, 55, 57, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 91, 92, 98, 100, 101, 103, 105). The deposits lie within the north-central, central and west-central parts of the GRA. They occur within Precambrian schist and granite and Tertiary volcanics but appear to be associated with Tertiary hypabyssal rhyolite, rhyolite porphyry and granite porphyry intrusives. They occur largely as veins along shears, but in occurrence 55 ore minerals are disseminated in a rhyolite porphyry. Most of the occurrences carry Au, Ag, Cu, Pb and Zn, but occurrences 79, 83, 84, 85, and 88 carry W; occurrence 100 carries Mn; 80 and 86 carry As; and 86 carries Be. The most common minerals are pyrite, chalcopyrite, sphalerite, galena, and ruby silvers; less common are tetrahedrite, scheelite, wolframite, arsenopyrite, stibnite, pyrolusite and psilomelane. Only minor production has taken place from the above deposits.

Mid-Tertiary Sediments

Mid-Tertiary valley-fill sediments are widespread in central and southern Arizona, and since the discovery of the Anderson Mine (Sherborne et al., 1979), have become a prime target for uranium exploration. In order for a uranium deposit to form by the agency of groundwater or connate water, it is necessary to have an adequate uranium source rock, permeable sediments for water to flow through, and a reductant to precipitate the uranium. In the southern part of the GRA where the mid-Tertiary sediments are located, suitable source rocks may be the mid-Tertiary volcanics and possibly the Precambrian granites. The mid-Tertiary sediments are interbedded in the volcanics and they are suitably permeable. It is not known where the reductants are present, but past or present geothermal waters (Castle Hot Springs, Gt202) could be sufficiently reducing to cause uranium precipitation. Four uranium occurrences are located in the southern part of the GRA where mid-Tertiary sediments are interlayered with volcanic rocks (Scarborough and Wilt, 1979). They occur mainly within dolomites and limestones and register up to X5 background.

Late Tertiary Sediments

Late Tertiary sediments are present in all basins formed as a result of Basin and Range faulting. They underlie part of the southern end of the GRA. As in the case of the mid-tertiary sediments, adequate uranium source rocks and permeable horizons are present. Extensive organic reductants are not known to be present in these sediments but warm geothermal waters (Gt 201, 202) could be sufficiently reducing to cause uranium precipitation. No uranium occurrences are known to be present within the Late-Tertiary sediments in the GRA.

Recent Alluvium

Alluvium formed in present-day river valleys is a possible site for the concentration of placer gold, especially within the Hot Spring GRA where numerous hydrothermal gold deposits are present. Four placer gold occurrences are known within the GRA (2, 192, 193, 195). The greatest recorded production is from occurrence 192 where 50 oz. Au were produced. All the occurrences are located close to the Aqua Fria River, or its tributaries.

Geothermal

Extensive but low temperature geothermal resources are known to be present in southern Arizona (Jones, 1979). Factors that are favorable for the existence of substantial geothermal systems are: Presence of a high temperature heat source; presence of aquifers which allow large volumes of water to circulate through the hot rocks; and the presence of cap rocks which prevent the escape to the surface of at least some of the hot fluid.

In southern Arizona the intensity of volcanic activity has been waning during the past 9 m.y. and that may explain why most geothermal areas are at a low temperature. Aquifers and cap rocks are plentiful and extensive in Tertiary valley-fill sediments. In the Hot Springs GRA two areas of warm springs are present and both are in the southwestern part of the GRA close to mid-Tertiary volcanics which are probably interlayered with sediments. Occurrence 201 is a 500 m well which discharges water at 44°C. Occurrence 202 is the Castle Hot Springs which contains three springs at temperatures up to 55°C and discharge of 1287 liters/minute.

Mineral Economics

The assessment of the geological, energy and mineral resources favorability should rely upon not only geology, but must also be concerned with

economic factors and priorities. Discovery, recovery, cost of production of the resource from sources with varying qualities and/or concentrations are included in those considerations. Special consideraton must be given to the strategic and critical minerals and metals. As this project is of limited scope, and because of special difficulties in southwestern Arizona, economic analyses of various commodities can only be discussed briefly.

Some factors especially important to the evaluation of the mineral and energy resources of southwestern Arizona include the following:

1. The geology of the Hot Springs GRA is very complex and detailed information on the geology and mineral deposits of the WSAs is, for the large part, limited. This is multiplied by recent and ongoing reinterpretations of the geology of the Basin and Range in Arizona. In order to interpret the geology of the WSAs, and thus be able to project the types of mineral deposits that may be present in those areas, it is necessary to apply information about known areas of apparently similar geology to the interpretation of the geology of the WSAs. These are not optimum conditions. A wide variety of possibilities must be considered and, therefore, discussions of mineral economics must be considered tentative.
2. Contributing to the problems listed above, and creating some other distinct difficulties, are the ruggedness and roadless nature of the WSAs. Roadlessness, a criterion for WSAs, inhibits exploration and development of mineral resources due to poor access, distance to market, and other factors which increase the expense and difficulty of geological and mineral exploration.

3. A great number of commodities, including strategic and critical minerals and metals, are known to occur in the WSAs and their surrounding areas.
4. Considering all the above mentioned problems, it is very possible that sophisticated methods currently used by professional geologic explorationists have not been fully employed in southwestern Arizona. Most of the mines and occurrences in the GRA were discovered many years ago by prospectors using simple techniques.

No mineral occurrences have been reported to exist in the South Bradshaws East (020-084A) WSA, but similar geologic environments located elsewhere host base and precious metal veins and disseminations (gold plus the strategic commodities copper, silver, lead and zinc are possible) and the strategic commodity tungsten in veins.

The South Canyon (020-119) WSA is host to three deposits, all hydrothermal and related to Tertiary volcanism. Gold and the strategic commodities silver, copper and lead occur and ore deposit (105) has produced a small amount. Deposit 125 is actively being explored by N.D. Resources (please see a following section of this report).

There has been much recent speculation about the potential for oil and gas occurrences in the Basin and Range of southern Arizona. It has been suggested that the Overthrust Belt, related to oil occurrences from Canada to Utah, extends into Arizona as a wide NW-SE trending belt curling around the Colorado Plateau in the Basin and Range area (Peirce, 1982; Anschutz, 1980). The theory states that around 60 m.y.B.P. older crystalline rocks thrust over younger, possibly oil-rich, strata (Peirce, 1982). The complex structures, including Basin and Range faults, found in southern Arizona coupled with the

high temperatures created by igneous activity since that time dim the possibility of preservation of oil and gas. Peirce (1982) states if the Overthrust Belt exists, or ever has existed, in Arizona, geologic complexity obscures it and drilling has not yet resolved the issue. Anschutz (1980) suggests that the Overthrust Belt could become the most important oil and gas province to be discovered in the last 20 to 30 years, but also states that it is one of the most difficult and expensive areas to explore and develop.

Strategic and Critical Minerals and Metals

Within the WSAs of the Hot Springs GRA are a few occurrences of the strategic and critical minerals and metals silver, lead and copper, with zinc and tungsten potential commodities.

Zinc has a variety of industrial applications, the most important being zinc-base alloy die castings, galvanizing iron and steel products, and brass production. Much of the lead used in the United States is consumed in the manufacture of storage batteries and as a gasoline additive, although use in gasoline is not as important as it once was. Use in ammunition and solder is also important, increasingly so during wartime. More silver is consumed in photography in the United States in one year than this country produces during that time (Brobst and Pratt, 1973). Tungsten, which in addition to use in steel and chemicals, also enjoys use in non-ferrous alloys and as tungsten carbide. Copper, although considered a strategic and critical metal, occurs in abundance in Arizona.

In summary, it must be noted that the Hot Springs GRA contains a large number of mineral occurrences and many different commodities. Deposits of strategic and critical commodities, some which have produced, are known to occur in one WSA and surrounding parts of the GRA. Further exploration could lead to the discovery of potentially important deposits in the GRA and WSAs.

THE GEOLOGY, ENERGY AND MINERAL RESOURCES OF THE WILDERNESS STUDY AREAS

In this section each individual WSA is discussed with respect to its physiography, geology, mineral occurrences, resource potential, and recommendations for further work. For most of the WSAs, detailed and specific information is lacking; in these cases, information pertinent to the particular WSA will be summarized from the preceding sections. The classification of resource potential and level of confidence is according to the scheme provided by the Bureau of Land Management (attachment 9, dated March 24, 1982). The classification is summarized on the maps in Figures 6 through 9 and detailed below.

Classification Scheme

1. The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.
2. The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.
3. The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.
4. The geologic environment, the inferred geologic processes, the reported mineral occurrences, and the known mines or deposits indicate high favorability for accumulation of mineral resources.

Level of Confidence Scheme

A. The available data are either insufficient and/or cannot be considered as direct evidence to support or refute the possible existence of mineral resources within the respective area.

B. The available data provide indirect evidence to support or refute the possible existence of mineral resources.

C. The available data provide direct evidence but are quantitatively minimal to support or refute the possible existence of mineral resources.

D. The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

The South Bradshaws East WSA (020-084A)

Physiography

The WSA lies on the eastern slope of the Bradshaw Mountains overlooking the Agua Fria River valley. It is a steep hillside which slopes east and within the WSA has a relief of about 2000 feet.

Geology

The WSA is entirely underlain by Precambrian quartz monzonite which was probably emplaced during the Arizonian Revolution. The northeast corner of the WSA is close to the intrusive contact between the quartz monzonite and Yavapai Series schists.

Mineral Deposits

No mineral deposits are known to occur within the WSA. However, similar geologic environments elsewhere in the WSA contain mineral occurrences of the following types:

(a) Tungsten veins near granite-schist contacts. These occur to the west and north of the WSA.

(b) Vein and disseminated precious and base-metal mineralization associated with granodioritic Laramide intrusives. These lie mainly to the north and northwest of the WSA.

(c) Veins and disseminated precious and base metal deposits associated with mid-Tertiary rhyolitic intrusives. These are common in the northwestern half of the GRA.

Land Classification for GEM Resources Potential

Metallic Minerals

The WSA (area 1; fig. 6) is classified as having low favorability for the occurrence of metallic minerals at a confidence level of C. The reasons for the above classification are as follows:

(a) No mineral occurrences are known within the WSA. On the other hand:

(b) Elsewhere in the GRA, in areas with similar geologic environments, small metalliferous deposits are associated with Precambrian granite contacts, Laramide intrusives and mid-Tertiary intrusives.

Other Resources

The WSA is not favorable for the occurrence of other resources at a confidence level of B because there are no indications suggesting their presence or as in the case of saleable resources, there are no nearby markets.

Recommendations

For area 1 it is recommended that the area be field checked for evidence of widespread hydrothermal alteration that could be associated with Precambrian, Laramide, or mid-Tertiary hydrothermal deposits.

The South Canyon WSA (020-119)

Physiography

The WSA lies within the Hieroglyphic Mountains. It occupies a hilly area overlooking the Phoenix basin and the Agua Fria River valley. The relief within the WSA is about 1500 feet.

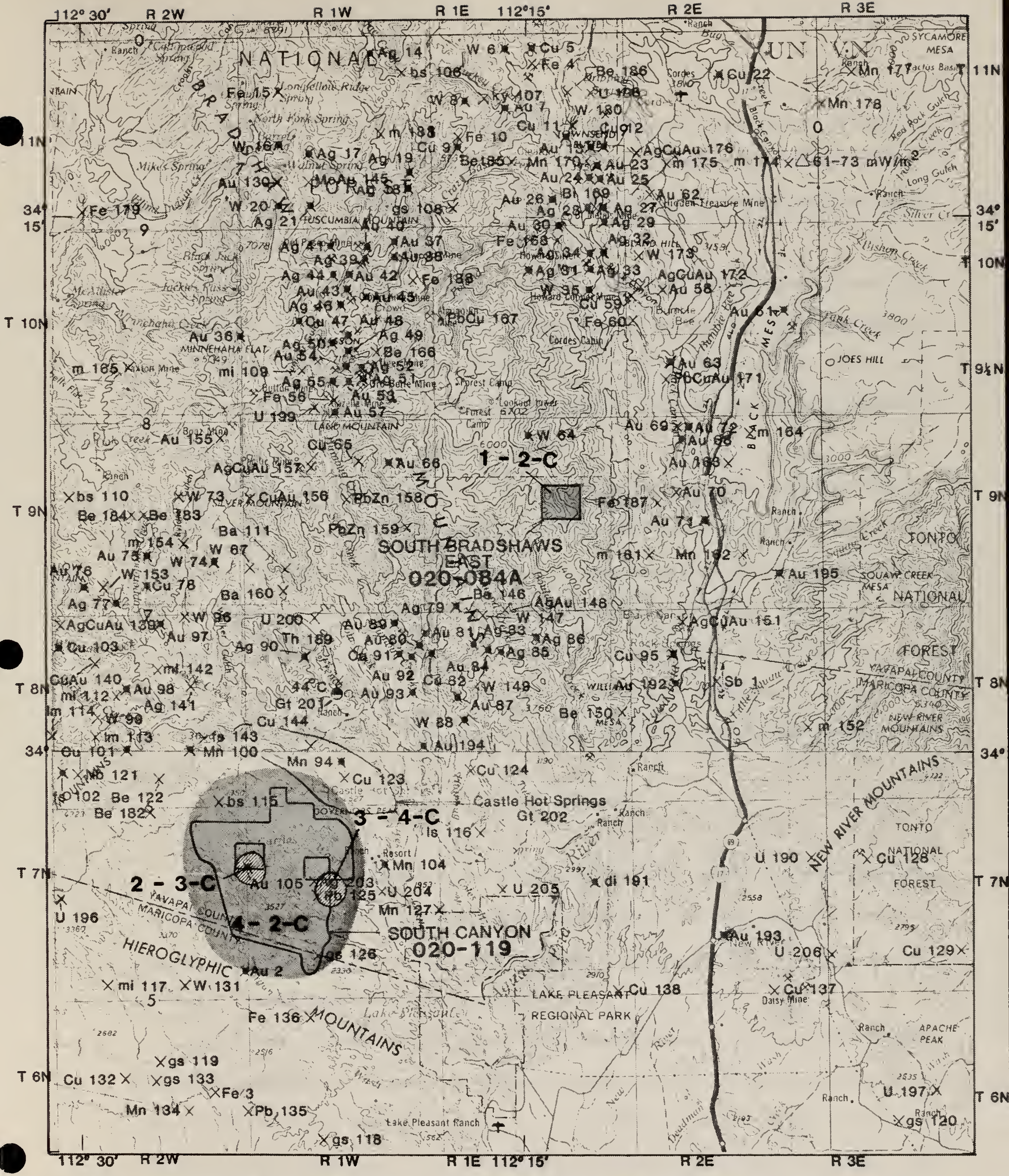


FIG.6 FAVORABILITY AND LEVEL OF CONFIDENCE MAP FOR METALLIC MINERAL RESOURCES OF THE HOT SPRINGS AREA, ARIZONA

Geology

The area is underlain by Precambrian schist and mid-Tertiary volcanics and intrusives. The Precambrian rocks crop out in the southwest corner of the WSA and consist of coarse to fine-grained metasediments and exhalites with minor volcaniclastics (Donnelly and Hahn, 1981).

The mid-Tertiary rocks crop out extensively over the WSA and consist of andesite flows, breccias and tuffs, and dacitic to rhyolitic flows and tuffs. They probably correspond to the middle unit of Eberly and Stanley (1978) and are likely to be interbedded with some sediments. The intrusives are probably the same composition as the volcanic rocks.

It has recently been brought to our attention that the geologic map is incorrect near the eastern boundary of the WSA near occurrence 125 (N.D. Resources, letter of August 25, 1982). At this location (T7N, R1W, sec. 21, 22) a window of older rocks is exposed below the Tertiary volcanics. It consists of Precambrian schist and granite, which along their contact, are intruded by a quartz monzonite. The quartz monzonite is strongly sericitized along a NNE-trending zone that can be traced 1000 feet within the boundary of the WSA.

Mineral Deposits

Three mineral occurrences are located within the WSA--105, 125 and 126. Occurrence 105 (the Golden Slipper Mine) contains Au and minor Cu and Ag mineralization which occurs in a vein, along a shear cutting rhyolite, dacite and tuff. Small production is reported.

Occurrence 125 has been reported as a Pb occurrence, but we have recently been informed by N.D. Resources (letter of August 25, 1982) that Ag, Au and Cu mineralization is present in the area. It occurs at two separate locations: The first coincides with the NNE-striking altered zone that is 1000 feet

long, and the other is 200 to 300 feet east, and is an Ag, Cu and Au-bearing quartz vein which strikes N-S and is about 600 feet long. Tonnage and grade estimates are confidential.

Occurrence 126 is an unspecified gem occurrence with no recorded production.

Land Classification for GEM Resources Potential

Metallic Minerals--The area near occurrence 105 (area 2; fig. 6) is classified as moderately favorable for metallic minerals at a confidence level of B. The reasons for this classification are as follows:

a. Au, Cu, Ag mineralization with some production is present.

b. Mid-Tertiary hydrothermal mineralization is widespread in the GRA.

The area near occurrence 125 (area 3; fig. 6) is classified as highly favorable for metallic minerals at a confidence level of C. The reasons for this classification are as follows:

a. A persistently mineralized, hydrothermally altered zone extends for 1000 feet and carries significant disseminated Ag, Au and Cu values.

b. A mineralized vein extends for about 600 feet and carries significant Ag, Au and Cu values.

c. The zone with disseminated mineralization extends beneath younger volcanic cover and thus could be more extensive.

The remainder of the WSA (area 4; fig. 6) is classified as having low favorability for metallic minerals at a confidence level of C. The reasons for this classification are as follows:

a. No occurrences are known within this area. On the other hand:

b. Mid-Tertiary precious metal and base metal mineralization is widespread in the GRA.

Uranium--The entire WSA where mid-Tertiary volcanics crop out (area 4; fig. 7) is considered to have low favorability for uranium at a confidence level of B. The reasons for this classification are as follows:

a. No uranium occurrences are known within the area. On the other hand:

b. Uranium occurrences are found in similar age rocks elsewhere in the GRA.

c. Suitable source rocks and permeable strata are probably present.

d. Geothermal waters could have acted as suitable reductants.

Geothermal--The northeast part of the WSA (area 6; fig. 8) is considered to have a low favorability for geothermal energy at a confidence level of B. The reasons for this classification are as follows:

a. A low temperature geothermal field is present to the north of the WSA.

b. The Tertiary volcanics are permeable and contain tuffs that may be impermeable.

Non-Metallic--The area near occurrence 126 (area 5; fig. 9) is considered to have low favorability for non-metallics at a confidence level of B, because of the presence of an unspecified gem locality with no recorded production.

Recommendations

For areas 1, 2 and 3 it is recommended that:

a. The areas be field checked for the presence of extensive hydrothermal alteration.

b. The areas should be checked for the presence of disseminated mineralization associated with hypabyssal intrusive rocks and for presence of breccia pipes.

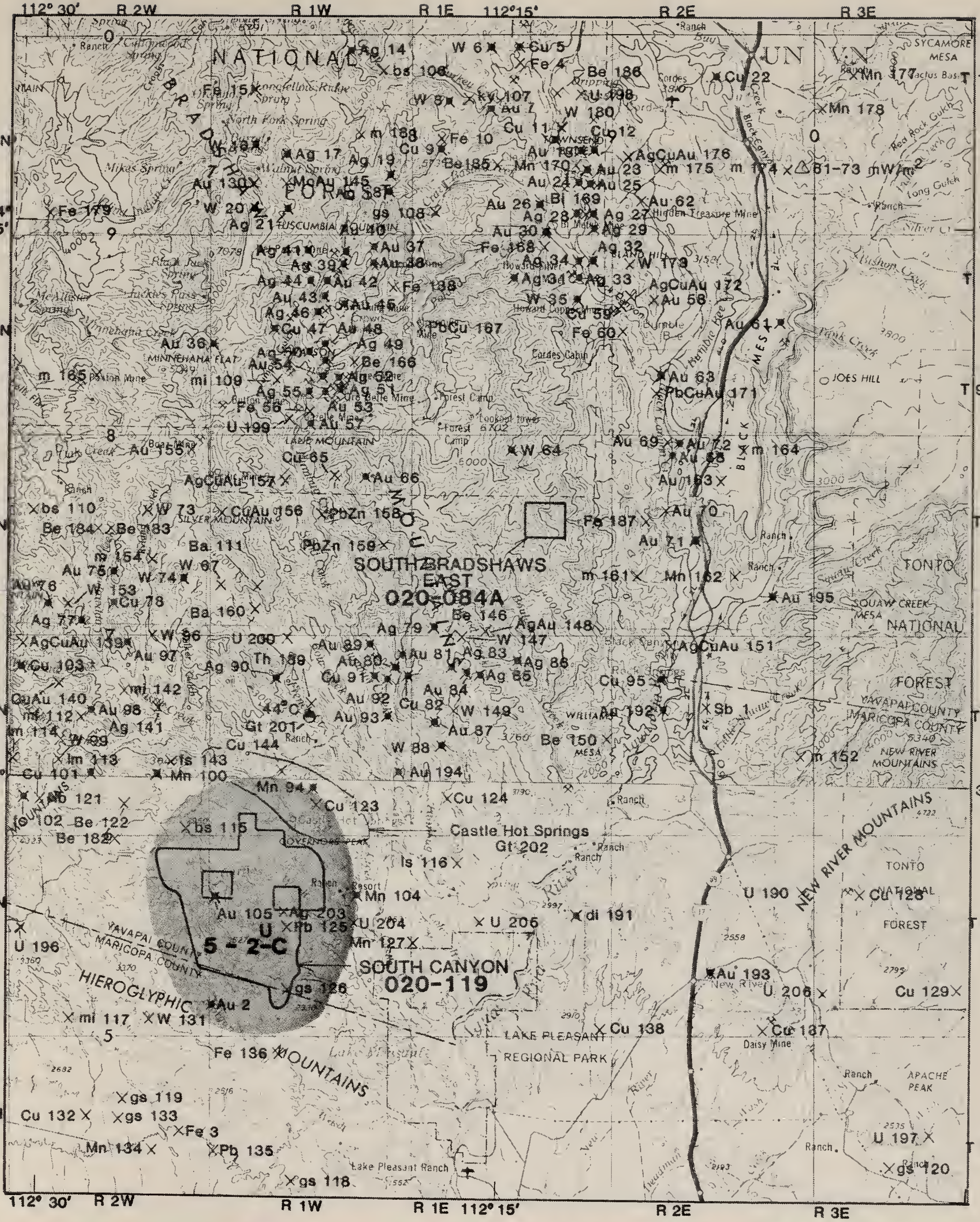


FIG.7 FAVORABILITY AND LEVEL OF CONFIDENCE MAP FOR URANIUM RESOURCES OF THE HOT SPRINGS AREA, ARIZONA

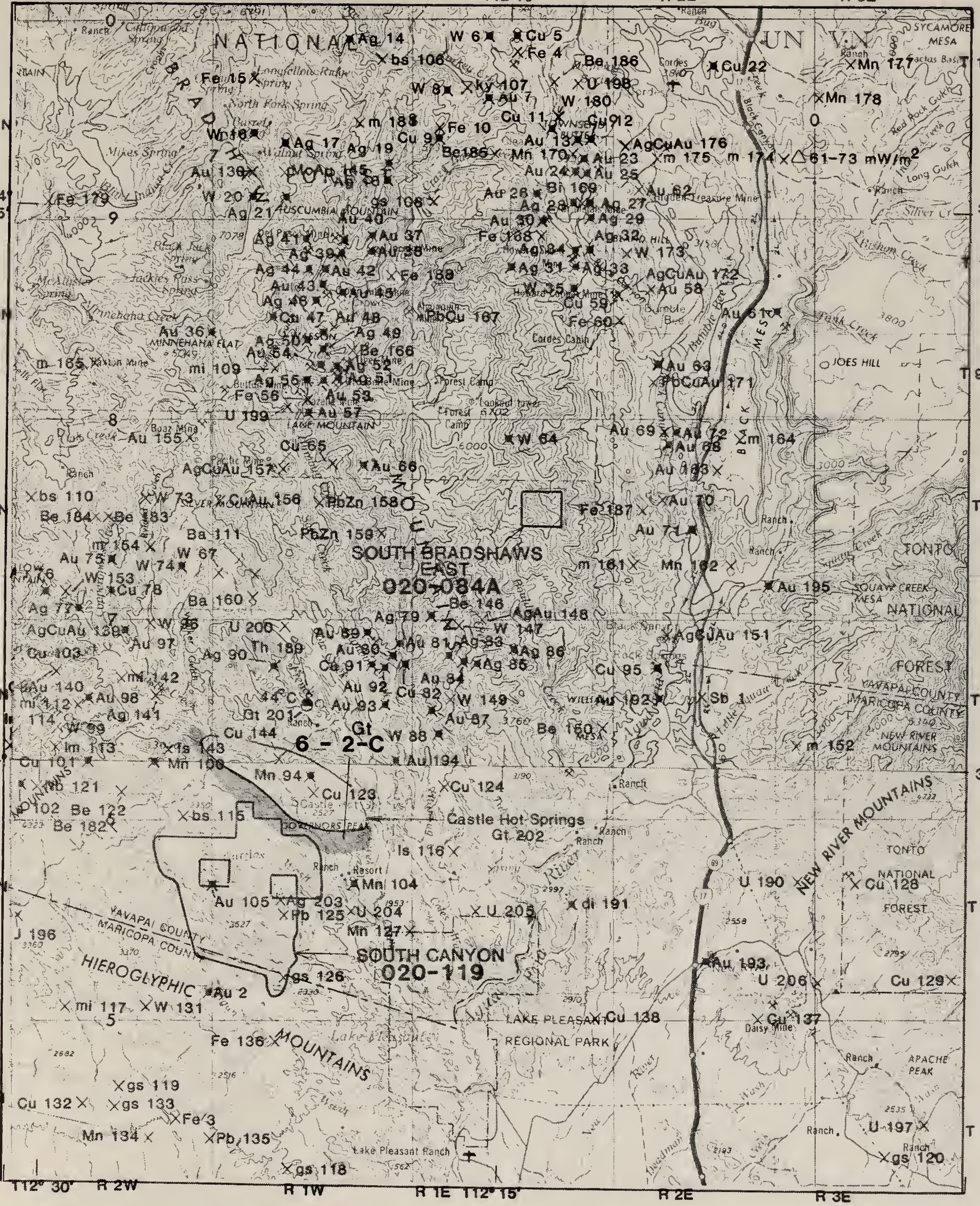


FIG.8 FAVORABILITY AND LEVEL OF CONFIDENCE MAP FOR GEOTHERMAL RESOURCES OF THE HOT SPRINGS AREA, ARIZONA

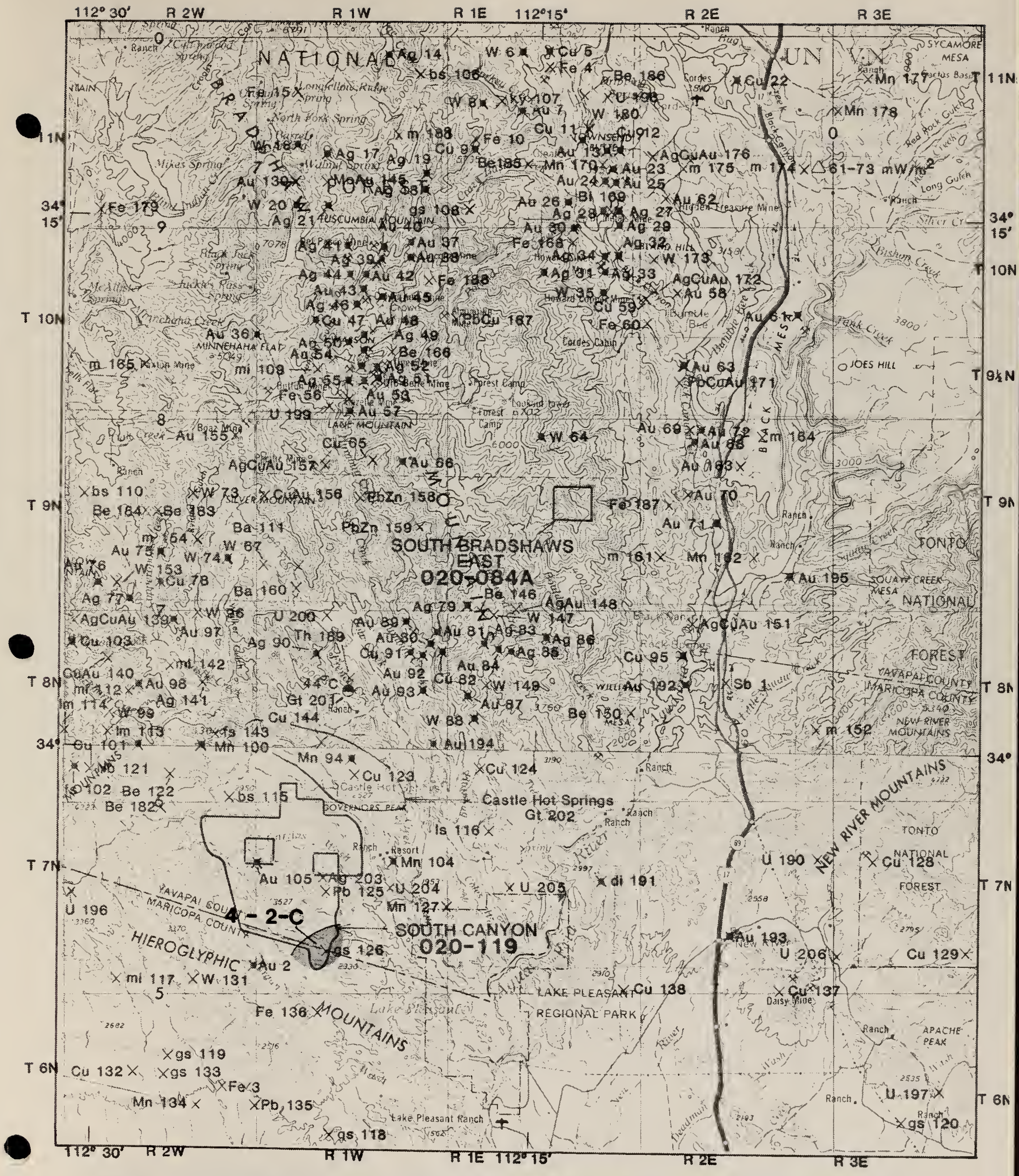


FIG.9 FAVORABILITY AND LEVEL OF CONFIDENCE MAP FOR NON-METALLIC RESOURCES OF THE HOT SPRINGS AREA, ARIZONA

c. Hydrothermally altered rocks should be radiometrically dated in order to determine whether the hydrothermal process was Laramide or mid-Tertiary.

For area 4 it is recommended that:

a. The area be field checked for presence of adequate uranium source rocks, aquifers and reductants.

b. Well and spring waters should be analysed for components that would allow the solubility index for various uranium minerals to be calculated.

For area 5 it is recommended that the gemstone occurrence be examined to determine the nature of the gem mineral.

For area 6 it is recommended that the area be examined for presence of evidence of recent hot springs.

REFERENCES

Anderson, C.A. and Silver, L.T., 1976, Yavapai Series - a greenstone belt, in Wilt, J.C. and Jenney, J.P., eds. Tectonic Digest: Arizona Geological Society Digest, v. 10, p. 13-26.

Anderson, C.A. and Nash, J.T., 1972, Geology of the massive sulfide deposits at Jerome, Arizona - A reinterpretation; Economic Geology, v. 86, p. 845-863.

Anderson, P., 1976, Proterozoic convergent plate tectonics [abs.]: 25th International Geologic Congress, v. 1, p. 73.

Anderson, P. and Guilbert, J.M., 1979, the Precambrian massive sulfide deposits of Arizona - A district metallogenic epoch and province, in Ridge, J.D., ed., Papers on mineral deposits of western North America: Nevada Bureau of Mines and Geology Report 33, p. 39-48.

Anschutz, P.F., 1980, The overthrust belt: will it double U.S. gas reserves?: World Oil, January 1980, p. 111-116.

Arizona Bureau of Mines, 1969, Mineral and water resources of Arizona: Arizona Bureau of Mines Bulletin 180, 638 p.

Burchfiel, B.C., 1979, Geologic history of the central western United States, in Ridge, J.D., ed., Papers on mineral deposits of western North America: Nevada Bureau of Mines and Geology Report 33, p. 1-12.

Clark, K.F., Foster, C.T., and Damon, P.E., 1982, Cenozoic mineral deposits and subduction related magmatic arcs in Mexico: Geological Society of American Bulletin, v. 93, p. 533-544.

Coney, P.J. and Reynolds, S.J., 1977, Cordilleran Benioff zones: Nature, v. 270, p. 403-406.

Damon, P.E., 1968, Application of the potassium-argon method to the dating of igneous and metamorphic rocks within the basin ranges of the southwest, in Titley, S.R., ed., Southern Arizona Guidebook III: Arizona Geological Society, p. 7-20.

Damon, P.E., and Mauger, R.L., 1966, Epeirogeny - orogeny viewed from the Basin and Range Province: Transactions of the American Institute of Mining, Metallurgical and Petroleum Engineers, v. 235, p. 99-112.

Damon, P.E., Shafiqullah, M., and Clark, K.F., 1981, Age trends of igneous activity in relation to metallogenesis in the southern Cordillera, in Dickinson, W.R. and Payne, W.D., eds., Relations of tectonics to ore deposits in the southern Cordillera: Arizona Geological Society Digest, v. 14, p. 137-154.

Davis, G.H., 1981, Regional strain analysis of the superposed deformations in southwestern Arizona and the eastern Great Basin, in Dickinson, W.R. and Payne, W.D., eds., Relations of tectonics to ore deposits in the southern Cordillera: Arizona Geological Society Digest, v. 14, p. 155-172.

Dickinson, W.R., 1981, Plate tectonic evolution of the southern Cordillera, in Dickinson, W.R. and Payne, W.D., eds., Relations of tectonics to ore deposits in the southern Cordillera: Arizona Geological Society Digest, v. 14, p. 113-135.

Donnelly, M.E. and Hahn, G.A., 1981, A review of the Precambrian volcanogenic massive sulfide deposits in central Arizona and the relationship to their depositional environment, in Dickinson, W.R. and Payne, W.D., eds., Relations of tectonics to ore deposits in the southern Cordillera: Arizona Geological Society Digest, v. 14, p. 11-22.

Eberly, L.D. and Stanley, T.B. Jr., 1978, Cenozoic stratigraphy and geologic history of southwestern Arizona: Geological Society of America Bulletin, v. 89, p. 921-940.

Elston, W.E., 1978, Mid-Tertiary cauldrons and their relationship to mineral resources, southwestern New Mexico: A brief review: New Mexico Geological Society Special Publication 7,p. 107-113.

Fenneman, H.M., 1931, Phsyiography of western United States: New York, McGraw-Hill, 534 p.

Heidrick, T.L. and Titley, S.R., 1982, Fracture and dike patterns in Laramide plutons and their structural and tectonic implications, in Titley, S.R., ed., Advances in geology of the porphyry copper deposits: Tucson, The University of Arizona Press, p. 73-91.

Johnson, M.G., 1972, Placer gold deposits of Arizona: U.S. Geological Survey Bulletin 1355, 103 p.

Jones, N.O., 1979, Geothermal resources - what to look for in Arizona: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 9, No. 3, p. 12-13.

Keith, S.B., 1981, The great southwestern Arizona overthrust oil and gas play: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 11, no. 1, p. 1.

Keith, S.B., 1980, The great southwestern Arizona overthrust oil and gas play: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 10, no. 1, p. 1-3, 6-8.

Keith, S.B., and Reynolds, S.J., 1980, Geochemistry of Cordilleran metamorphic core complexes, in Coney, P.J. and Reynolds, S.J., Cordilleran metamorphic core complexes and their uranium favorability: U.S. Department of Energy Open File Report GJBX-258(80), p. 274-303.

Lowell, J.D., 1974, Regional characteristics of porphyry copper deposits of the southwest: Economic Geology, v. 69, p. 601-617.

McCrory, F.J. and O´Haire, R.T., 1965, Map of known non-metallic mineral occurrences of Arizona: Arizona Bureau of Mines, scale 1:1,000,000.

Nielsen, R.L., 1979, Regional tectonics and the emplacement of Laramide porphyry copper intrusions - Arizona - New Mexico, in Ridge, J.D., ed., Papers on mineral deposits of western North America: Nevada Bureau of Mines and Geology Report 33, p. 49-56.

Oppenheimer, J.M. and Sumner, J.S., 1981, Gravity modelling of the basins in the Basin and Range Province, Arizona: Arizona Geological Society Digest, v. 13, p. 111-116.

Pierce, H.W., 1982, The search for petroleum in Arizona: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 12, no. 2, p. 1-5.

Rehrig, W.A. and Heidrick, T.L., 1976, Regional tectonic stress during the Laramide and late Tertiary intrusive periods, Basin and Range Province, Arizona, in Wilt, J.C. and Jenney, J.P., eds., Tectonic Digest: Arizona Geological Society Digest, v. 10, p. 205-228.

Rehrig, W.A. and Reynolds, S.J., 1980, Geologic and geochronologic reconnaissance of the northwest-trending zone of metamorphic core complexes in southern and western Arizona: Geological Society of America Memoir 153, p. 131-157.

Reynolds, S.J., 1980, A conceptual basis for the occurrence of uranium in Cordilleran metamorphic core complexes, in Coney, P.J. and Reynolds, S.J., Cordilleran metamorphic core complexes and their uranium favorability: U.S. Department of Energy Open File Report GJBX-258 (80), p. 187-246.

Reynolds, S.J., 1980, Geologic framework of west-central Arizona, in Jenney, J.P. and Stone, C., eds., Studies in western Arizona: Arizona Geological Society Digest, v. 12, p. 1-16.

Scarborough, R.B. and Wilt, J.C., 1979, A study of uranium favorability of Cenozoic sedimentary rocks, Basin and Range Province, Arizona, Part I, General geology and chronology of pre-Late Miocene Cenozoic sedimentary rocks: The University of Arizona and U.S. Geological Survey Open File Report 79-1429.

Schmitt, H.A., 1966, The porphyry copper deposits in their regional setting, in Titley, S.R. and Hicks, C.L., eds., Geology of the porphyry copper deposits, southwestern North America: Tucson, University of Arizona Press, p. 17-33.

Shafiqullah, M., Damon, P.E., Lynch, D.J., Reynolds, S.J., Rehrig, W.A., and Raymond, R.H., 1980, K-Ar geochronology and geologic history of southwestern Arizona and adjacent areas: Arizona Geological Society Digest, v. 12, p. 201-260.

Sherborne, J.E., Buckovic, W.A., Dewitt, D.B., Hellinger, T.S., and Pavlak, S.J., 1979, Major uranium discovery in volcanoclastic sediments, Basin and Range Province, Yavapai County, Arizona: American Association of Petroleum Geologists Bulletin, v. 63, p. 621-646.

Silver, L.T., 1978, Precambrian formation and Precambrian history in Cochise County, southeastern Arizona, in Callender, J.F., Wilt, J.C., and Clemons, P.E., eds., Land of Cochise: New Mexico Geological Society Guildebook, 29th Field Conference, Socorro, p. 157-163.

Silver, L.T., Bickford, M.E., and Van Schinns, W.R., 1977, the 1.4 - 1.5 b.y. transcontinental anorogenic plutonic performation of North America [abs.]: Geological Society of America Abstracts with Programs, v. 9, p. 1176-1177.

Stipp, T.F., Hargler, L.B., Alto, B.R., and Sutherland, H.L., 1967, Reported occurrences of selected minerals in Arizona: U.S. Geological Survey Mineral Investigations Resources Map MR-46, scale 1:500,000, 2 sheets.

Titley, S.R., 1982, Geologic setting of the porphyry copper deposits, in Titley, S.R., ed., Advances in geology of porphyry copper deposits: Tucson, University of Arizona Press, p. 37-58.

Titley, S.R., 1981, Geologic and geotectonic setting of porphyry copper deposits in the southern Cordillera, in Dickinson, W.R. and Payne, W.D., eds., Relations of tectonics to ore deposits in the southern Cordillera: Arizona Geological Society Digest, v. 14, p. 79-97.

U.S. Geological Survey, 1982, Computerized Resources Information Bank (CRIB): Computer printout records of August 2, 1982.

U.S. Geological Survey, 1972 (some entries revised 1979), CRIB Mineral Resources File 12, (see individual mineral deposit descriptions for record and page numbers).

Warner, L.A., 1978, The Colorado lineament - A middle Precambrian wrench fault system: Geological Society of America Bulletin, v. 89, p. 161-171.

Wilson, E.D., 1962, A resume of the geology of Arizona: Arizona Bureau of Mines Bulletin 171, 140 p.

Wilson, E.D., Moore, R.T., and Cooper, J.R., 1969, Geologic map of Arizona: Arizona Bureau of Mines and the U.S. Geological Survey, scale 1:500,000.

Witcher, J.C., Stone, C., and Mahman, W.R., 1982, Geothermal Resources of Arizona map: Arizona Bureau of Mines and Mineral Technology, scale 1:500,000.